# Wisconsin Component Manual

Orenco Systems®
Incorporated
1-800-348-9843

## Contents

# Overview
# AdvanTex® Treatment Systems

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Orenco's AdvanTex® Treatment Systems are an innovative technology for onsite treatment of wastewater. The heart of the System is the AdvanTex filter, a sturdy, watertight fiberglass basin filled with an engineered textile material. This lightweight, highly absorbent textile material treats a tremendous amount of wastewater in a small space. That's because textile has a very large surface area for biological breakdown of wastewater components – about five times greater than that of an equivalent volume of sand. Yet the AdvanTex filter has a very small footprint.

## System Performance

Orenco Systems® has been researching, designing, testing, and selling a variety of textile filters for nearly a decade. More than 15,000 textile filters have been installed throughout the United States and Canada, on sites ranging from federal demonstration projects to university testing facilities, single-family homes, commercial properties, and community systems.

Unlike other wastewater treatment technologies, the AdvanTex Treatment System provides consistent, reliable wastewater treatment, even during "peak flow" conditions. The AdvanTex Treatment System includes a processing tank and a control panel with a programmable dosing timer. So it discharges small amounts of treated wastewater, regularly, throughout the day.

AdvanTex treats residential-strength waste to better than "secondary" standards. Effluent can be used for drip or subsurface irrigation, or discharged to shallow, inconspicuous trenches. It can also be discharged to fine-grained polishing filters for coliform removal and water reuse.

## Third-Party Performance Verification

AdvanTex Treatment Systems have undergone lengthy performance testing to ANSI and NSF/ANSI standards. This third party testing (NSF Final Report, April 2002) of treatment performance recorded a maximum 30-day arithmetic mean of 8 mg/L for $CBOD_5$ and 6 mg/L for suspended solids. Over the six-month course of the evaluation, the average effluent $CBOD_5$ was 5 mg/L, and the average effluent suspended solids was 4 mg/L.

## System Benefits

Significantly smaller land area is required for the AdvanTex Treatment System than is required for sand and gravel filters. That's because textile has demonstrated the capacity to support microbial populations that can treat filtered processing tank effluent at greater hydraulic loading rates. In fact, loading rates for AdvanTex Treatment Systems are typically 5-20 times higher than for sand filters. In addition, reductions in drainfield size are often permitted with AdvanTex Treatment Systems. Moreover, textile is lightweight, making it ideal for prepackaging and shipping, which simplifies installation and reduces costs.

## Applications

The AdvanTex Treatment System is ideal for...

- New construction
- System upgrades and repairs
- Pretreatment of moderately high-strength waste
- Wherever typical secondary treatment standards suffice

# AdvanTex®-AX Filters Overview, cont.

## System Operation and Maintenance

AdvanTex is easy to service, easy to clean, and generates virtually no troublesome activated sludge. Like most advanced technologies, the AdvanTex Treatment System requires regular maintenance. As a condition of warranty, property owners must purchase a service contract from a certified third party provider.

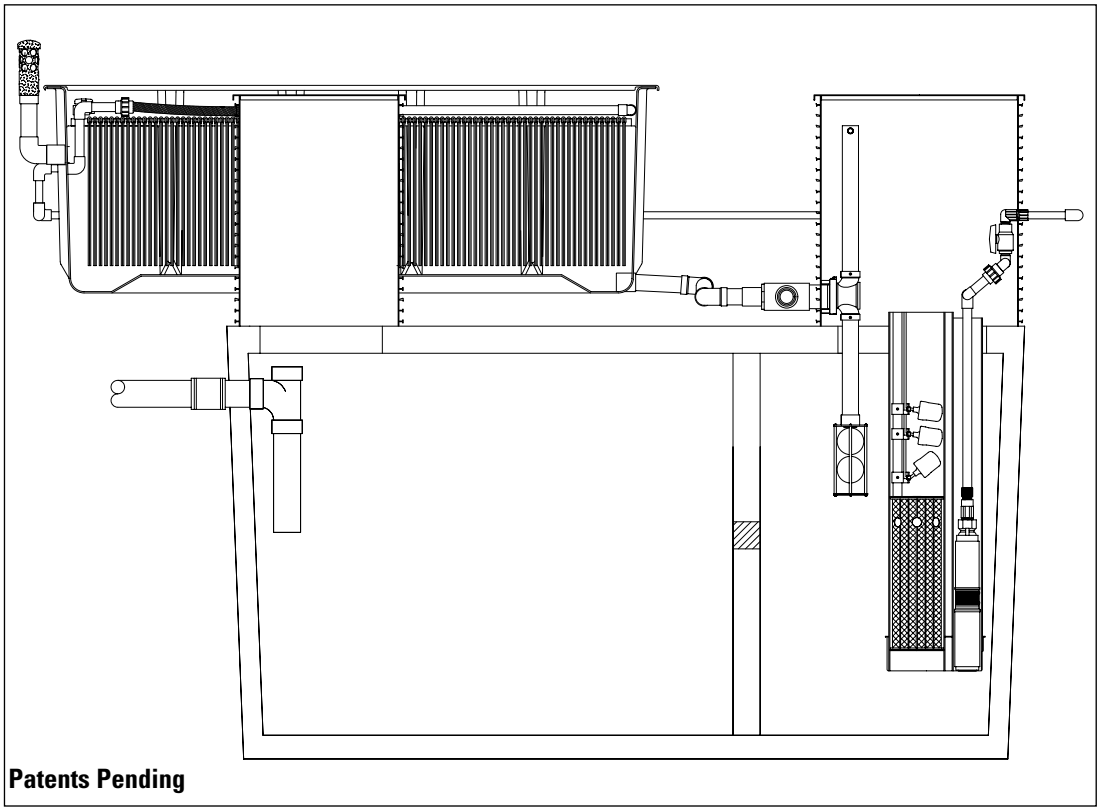
The AdvanTex Treatment System comes standard with a VeriComm® telemetry control panel with a Web-based monitoring system, supervised by the System's service provider. Alarm notifications are automatically sent to the service provider's e-mail capable device. Messages are resent until the condition has been cleared. As a back-up, the VeriComm control panel also has an audible alarm. And the System is sized to allow for a minimum of 24 hours of wastewater storage (at average daily flows). That means an operator can provide service to the system during normal working hours, regardless of when an alarm occurs.

The AdvanTex System's pumps typically run 30-60 minutes per day, so AdvanTex uses very little power . . . an average of $1.25-2.50 per month (based on the national average of eight cents per kilowatt hour). Compare that to power costs of up to $20-$60 per month for many "activated sludge" aerobic treatment units.

## Treatment Methodology

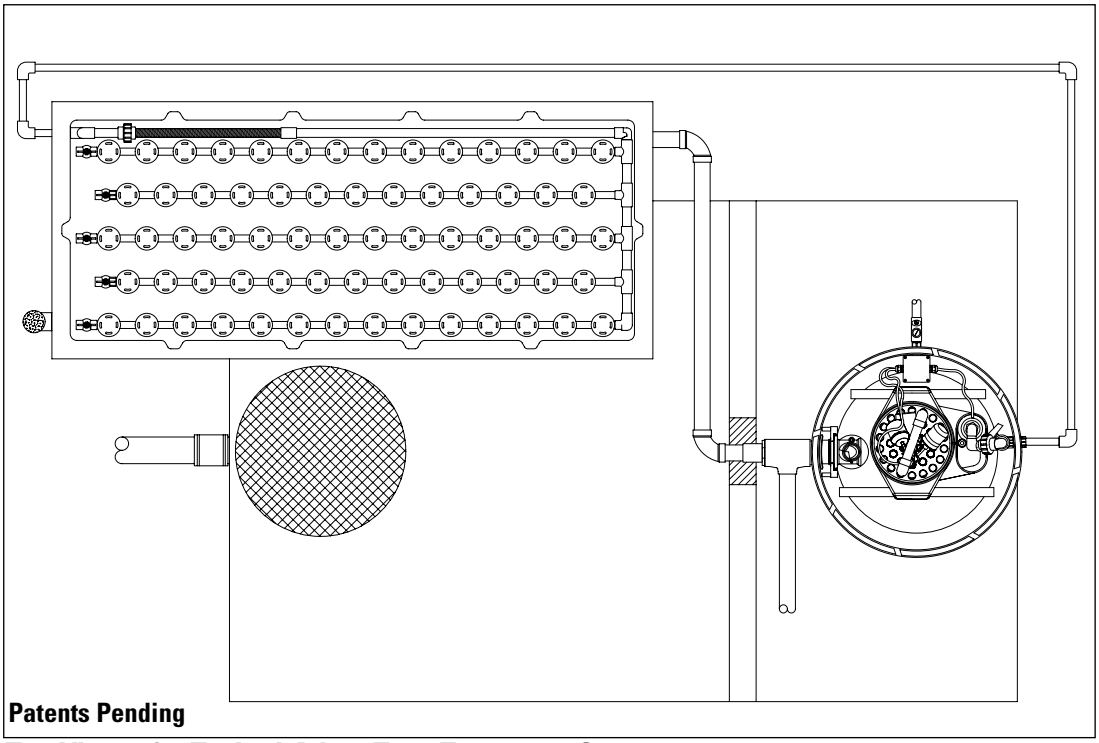
The AdvanTex Treatment System works just like a recirculating sand filter: a reliable, proven technology that Orenco's engineers have helped to perfect over the past 25 years. While the treatment process is similar, the proprietary treatment module is more efficient.

In an AdvanTex Treatment System, wastewater percolates through the textile media, whose complex fiber structure provides tremendous water-holding capacity and offers an extremely large surface area for biomass attachment. A visible biological film normally develops on the filter medium within a few days. $BOD_5$ and TSS reductions occur almost immediately.



**Patents Pending**

**Side View of a Typical AdvanTex® Treatment System**



**Patents Pending**

**Top View of a Typical AdvanTex® Treatment System**

# AdvanTex® Design Criteria

Orenco Systems® Incorporated
1-800-348-9843

## *For Residential Applications**

**System Description and Treatment Process**
The AdvanTex® Treatment System is a multiple-pass, packed-bed aerobic wastewater treatment system specifically designed and engineered for long-term processing of residential strength wastewater. The treatment media is an engineered textile, which has an extremely high void capacity, moisture-holding capacity, and surface area per unit volume. Consequently, AdvanTex Treatment Systems are capable of processing residential strength wastewater to better than "secondary standards" (see page 4, Figures 3a and 3b).

**Fig. 1a**
**AdvanTex Treatment System: Side View**

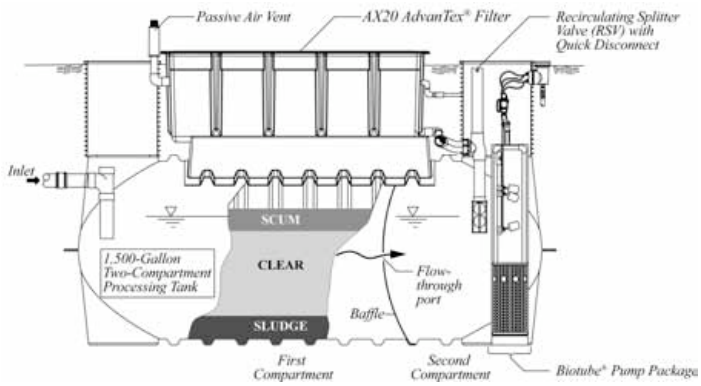
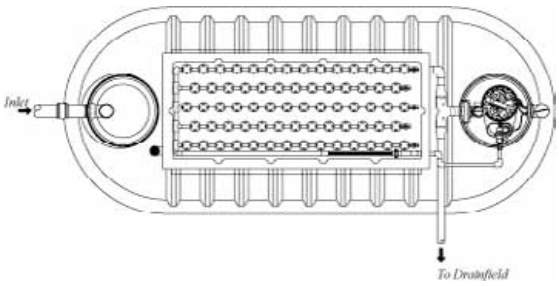



**Fig. 1b**
**AdvanTex Treatment System: Top View**




Here's how it works in our standard configuration (see Fig. 1a and Fig. 1b). Raw sewage enters the two-compartment Processing Tank through its inlet tee. In the first compartment, the raw sewage separates into three distinct zones: a scum layer, a clear layer, and a sludge layer. A flow-through port(s) in the tank's baffle wall allows effluent from the clear layer to flow into the second compartment of the tank. The Biotube® Pump Package in the second compartment pumps filtered effluent to a distribution manifold in the AdvanTex filter. Effluent percolates down through the textile media and is collected in the bottom of the filter pod. The treated effluent flows out of the filter pod through the filtrate return line, which returns the treated effluent to the recirculating splitter valve (RSV). The RSV automatically splits or diverts the flow between the processing tank and the final discharge. The RSV also controls the liquid level within the processing tank. During extended periods of no flow, 100 percent of the treated filtrate effluent is returned to the processing tank. The residential AdvanTex filters have a passive vent system and do not require the use of a fan.

**System Selection: Models and Configurations**
Residential-sized AdvanTex Treatment Systems include the AX20 and the AX20N. These models are identical; however, the AX20N's label carries the NSF mark, per NSF protocol, and is sold in jurisdictions that require NSF-certified product tracking.

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* *This document is for residential applications only. For commercial applications, call Orenco Systems' Engineering Department.*

The AdvanTex Treatment System can be configured in several modes. Mode 1 (shown in Fig. 2a) is the operating configuration used most frequently. In Mode 1, the filtrate recirculates through the second compartment of the processing tank. In Mode 3 (a specialty mode, shown in Fig. 2b), a portion or all of the filtrate may be recirculated through the primary chamber of the tank to enhance nutrient removal. Some of the systems in Mode 1 incorporate two tanks: a primary tank and a recirculation tank. In the primary tank, sludge and scum are separated from liquid effluent, which then flows into a separate recirculation tank, into which the AdvanTex filtrate is recirculated (shown in Fig. 2c). Refer to AdvanTex Treatment System drawings for further details on mode and discharge options.

**Fig. 2a**
**Mode 1**

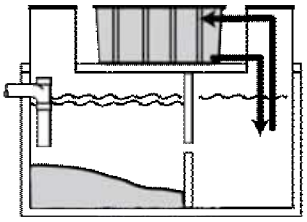


**Fig. 2b**
**Mode 3**

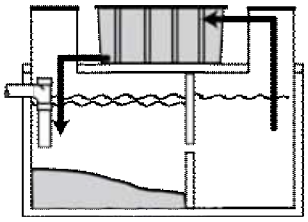
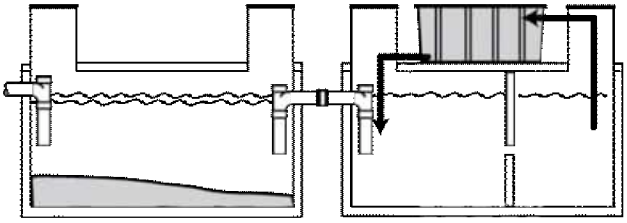


**Fig. 2c**
**Septic and Recirc Tanks**



**System Requirements: Residential Strength Wastewater**
Residential wastewater must meet the criteria in the "Residential Strength Wastewater" table, below. Consult Orenco or an authorized Dealer for larger system designs.

**Table 1. Residential Strength Wastewater (Influent Characteristics)***

| Characteristic | Average | Weekly Peak | Rarely Exceed |
|---|---|---|---|
| | *mg/L* | *mg/L* | *mg/L* |
| $cBOD_5$ | 130 | 200 | 300 |
| TSS | 40 | 60 | 150 |
| TKN | 65 | 75 | 150 |
| G&O | 20 | 25 | 25 |

**Maximum allowable wastewater strength pumped to an AdvanTex Treatment System is "Residential Strength Wastewater." Residential strength wastewater is defined as primary sewage effluent from a septic tank that does not exceed the above parameters.*

**System Requirements: Processing Tank**
Homes with up to four bedrooms require a minimum two-compartment, 1,500-gal (5,678-L) tank with flow-through port(s) equaling a minimum flow-through area of not less than 12 $in^2$ (77 $cm^2$) at 60 to 70 percent of the lowest normal liquid level (see the drawing *Typical Liquid Level Positions*, NDA-ATX-MF). In larger residential systems, the first compartment should be sized at approximately 2/3 to 3/4 of the total processing tank volume.

All tanks must meet Orenco's minimum structural requirements, be completely watertight, and pass a watertight test, including the riser/tank connection. For detailed specifications, see structural and watertightness criteria in Orenco's *General Specifications,* NDA-DG-SPEC-1, and the tank specifications checklist in Orenco's *Concrete Tank Questionnaire,* NCL-TNK-TNK-1.

**System Selection: Required Tankage and Filter Units**

The following tables summarize the required tankage and required number of textile filter units based on occupancy and maximum design flow. Table 2 is for systems using a single processing tank. Table 3 is for systems using separate septic and recirculation tanks.

Requirements assume that residential peak weekly average flows ($Q_{pwa}$) are typically two times normal average daily flows ($Q_a$) (in other words, $Q_{pwa} = 2Q_a$), and peak weekly average flows meet typical regulations governing gpd-to-bedroom ratios.

**Table 2. Required Tankage and Number of Filter Units: Systems Using Single Processing Tank**

| # Bedrooms[1] | Occupants[2] | Processing Tank[3] | AX Units[4] |
|---|---|---|---|
| | *maximum* | *minimum size (gal)* | *model* |
| 4 or fewer | 8 | 1,500 (5,678 L) | 1-AX20 |
| 5 | 10 | 2,500 (9,464 L) | 2-AX20 |
| 6 | 12 | 3,000 (11,356 L) | 2-AX20 |

[1] *Use bedrooms as default sizing criteria. (States vary greatly on calculations of gallons per bedroom.) For homes with more than six bedrooms or larger than 5,000 ft² (465 m²), consult Orenco Systems, Inc.*

[2] *Systems with occupancies greater than eight require a design with multiple units based on a minimum of 2.5 ft² (0.2 m²) of surface loading area per capita.*

[3] *Processing tank includes primary (septic) and secondary (recirculation) compartments.*

[4] *The hydraulic application rate for all residential AX units is 29.1 gpd/ft² (10.2 L/m²/day); the nominal hydraulic application rate is 25 gpd/ft² (8.8 L/m²/day).*

**Table 3. Required Tankage and Number of Filter Units: Systems Using Separate Septic/Recirc Tanks***

| # Bedrooms[1] | Occupants[2] | Septic Tank | Recirc Tank[3] | AX Units[4] |
|---|---|---|---|---|
| | *maximum* | *minimum size (gal)* | *minimum size (gal)* | *model* |
| 4 or fewer | 8 | 1,000 (3,784 L) | 1,000 (3,784 L) | 1-AX20 |
| 5 | 10 | 1,500 (5,678 L) | 1,000 (3,784 L) | 2-AX20 |
| 6 | 12 | 2,000 (7,571 L) | 1,000 (3,784 L) | 2-AX20 |

** See Fig. 2c on previous page.*

[1] *Use bedrooms as default sizing criteria. (States vary greatly on calculations of gal/bedroom.) For homes greater than six bedrooms or greater than 5,000 ft² (465 m²), consult Orenco Systems, Inc.*

[2] *Systems with occupancies greater than eight require a design with multiple units based on a minimum of 2.5 ft² (0.2 m²) of surface loading area per capita.*

[3] *The 1,000-gal minimum is due to float settings/reserve requirements.*

[4] *The hydraulic application rate for all residential AX units is 29.1 gpd/ft² (10.2 L/m²/day); the nominal hydraulic application rate is 25 gpd/ft² (8.8 L/m²/day).*

**Design Loading Rates**

Orenco's suggested design loading rates are based on typical per capita flow rates (50 to 60 gal/day/person [189 to 227 L/day/person]) and average strength characteristics expected from residential type installations, as shown in Table 1. Performance is a function of the expected typical loads with periodic weekly highs. Typically, the daily mass loading is based on the expected daily flows and actual strength. Figures 3a and 3b show periodic peak loading capacity at a 95% confidence level. If the

loading rate (or mass load) needs to be reduced to meet discharge limits, it's a simple matter of adding additional modular units.

Orenco Systems, Inc.'s AX20N AdvanTex Treatment System is listed as an NSF/ANSI Standard 40 Class I treatment unit, and the listing is for flows up to 1,500 gpd (5,678 L/d) in various configurations.

**Typical Effluent Quality**

Effluent quality is dependent on a number of factors, including influent characteristics and loading rates. The following charts show third party, NSF/ANSI Standard 40 testing results. The results demonstrate that low-to-moderate loading rates typically produce cBOD and TSS of <5 mg/L, while higher loading rates produce cBOD and TSS in the range of 15-25 mg/L. Field testing of systems in real-world conditions shows similar results, with cBOD and TSS of <10 mg/L. (See *AX Performance Summary,* AHO-ATX-PERF-1.)

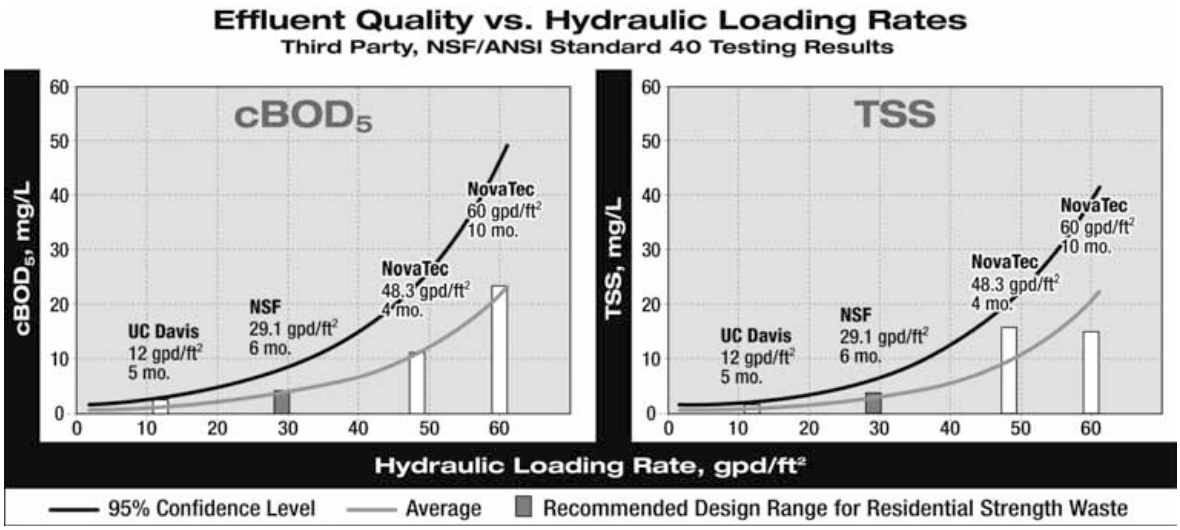



**Fig. 3a – $cBOD_5$** **Fig. 3b – TSS**

Nitrogen reduction in Mode 1 will typically exceed 60 percent, with total nitrogen in the filtrate ranging between approximately 25 and 35 mg/L. In Mode 3, nitrogen reduction can reach 70 percent or better, depending on wastewater strength and other characteristics like grease and oils, pH, and alkalinity concentrations. Nitrification can be inhibited if the buffering capacity (alkalinity) of the wastewater is too low. On a theoretical basis, 7.14 mg/L of alkalinity as $CaCO_3$ is needed to nitrify 1 mg/L of $NH_4^+$.

**Pumping Equipment: Recirc Pump**

The integrated treatment package includes an Orenco Biotube® pump package.

**Residual Head Pressures**

A 5-foot (1.5-m) residual pressure is used to determine the initial time-dosing settings. (Residual pressures may vary depending on system hydraulics and/or special treatment requirements.) Consulting with Orenco is required when the residual pressure dosing falls outside the typical 3- to 6-foot (0.9- to 1.8-m) range.

**Recirculation Ratios and Timer Settings**
The AdvanTex Treatment System's initial timer settings should be established based on the expected average daily flow and a 4:1 recirculation ratio (filter recirculation ratio). If flows vary significantly from expected flows, timer settings can easily be recalculated and adjusted. See the *AdvanTex Installation Guide*, NIM-ATX-AX-1, "Appendix 1: AX20 Timer Settings Worksheet."

**AdvanTex Control System**
Critical to the success of the AdvanTex Treatment System is the method in which the effluent is loaded onto the AdvanTex textile filter. Over the past three decades, timer-controlled applications have proven to play an essential role in optimizing the performance of both fixed and suspended growth biological systems. A timer-controlled pump in the processing tank periodically doses effluent to a distribution system on top of the AdvanTex filter. Each time the filter is dosed, effluent percolates through the filter media and is treated by naturally occurring microorganisms that populate the filter. During periods of high flow, a timer override float will temporarily modify the timer settings to process the additional flow. Conversely, during periods of low flow, the timer settings can be modified to reduce loading onto the AdvanTex filter.

VeriComm's® remote telemetry control panels and Web-based monitoring system are incorporated into all AdvanTex Treatment System standard equipment packages. VeriComm gives wastewater system operators and maintenance organizations the ability to monitor and control each individual system's performance remotely. There are several additional operational benefits associated with telemetry-based controls, including Advanced Control Logic — functions that activate in the event of component malfunction to diagnose the system using pre-established trend data and, if necessary, modify the operation of the system until it can be serviced. VeriComm also provides additional alert and alarm functions to notify the operator/designer in the event that trend data indicate potential problem conditions (e.g., high flows).

**Surge Volume**
For most residential applications, the recommended surge volume is approximately 150 to 250 gallons (570 to 950 L). The actual surge volume used should be approximately 50 to 100 percent of the actual average daily flow. The surge volume is the volume between the normal low liquid level and the override timer float. The normal low liquid level is the level at which 100 percent of the filtrate returns to the tank. For most residential installations, the low liquid level will be approximately 5 to 6 inches (130 to 150 mm) to below the top of the RSV cage. See the drawing *Typical Liquid Level Positions*, NDA-ATX-MF, for a description of typical RSV and float settings for residential systems installed in two-compartment tanks. Refer to the *AdvanTex Installation Guide*, NIM-ATX-AX-1, for details.

**Reserve Volume**
A typical AdvanTex Treatment System on a four-bedroom home has a 1,500-gallon processing tank. There are about 400 gallons (1,500 L) of emergency storage between the normal operating liquid level and the inside top of the tank. Assuming that the average home produces about 250 gpd (950 L/d), the emergency storage volume in an AdvanTex system is sufficient for 1.5 days.

*Power outage:* During a power outage, water usage will be significantly reduced because water heaters, dishwashers, and laundry equipment will not be used. Under these conditions, it is realistic to estimate that water usage will be reduced by 50 percent to around 125 gpd (473 L/d). Therefore, in a power outage, the emergency storage capacity available in an AdvanTex system increases to approximately

three days' worth. Because power outages typically last no more than one day, the emergency storage of an AdvanTex system is adequate.

*Mechanical component failure:* Failure of a pump or electrical component may cause the system to stop operating, requiring some amount of emergency storage volume. The VeriComm Monitoring System immediately notifies the Authorized Service Provider of the alarm condition and indicates the cause of the alarm. This allows the Service Provider to bring the right replacement component. In most cases, no more than one day (250 gallons [950 L]) would be needed for the Service Provider to respond and get the system running again.

**Discharge Equipment**

There are two discharge options: gravity and pump. When discharging by pump, an Orenco pump basin can be used (Fig. 4a). Alternatively, some designs may call for pumping out of a tank (Fig. 4b).

**Fig. 4a**
**Pump Basin Discharge**

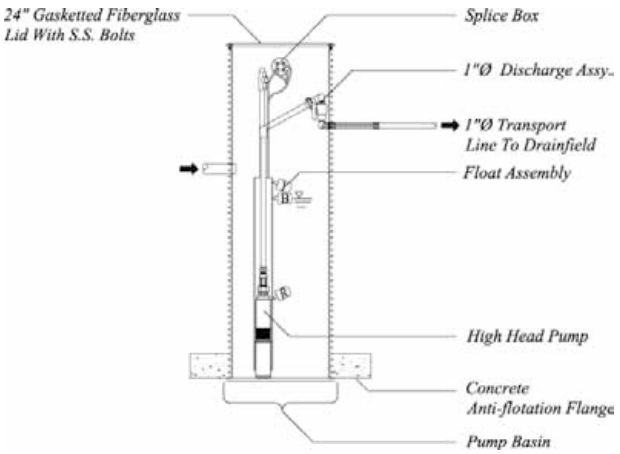
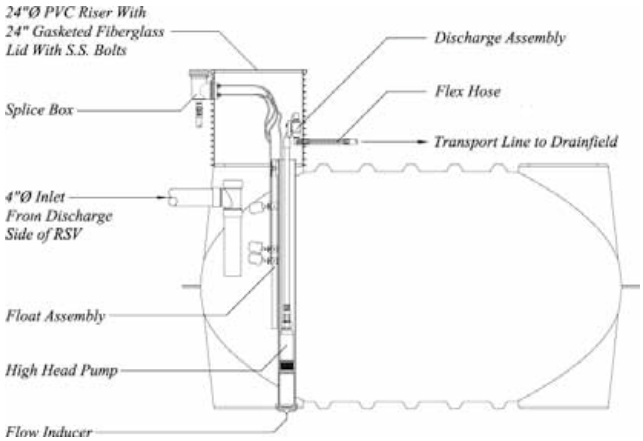



**Fig. 4b**
**Pump Tank Discharge**




All tanks must meet Orenco's minimum structural requirements, be completely watertight, and pass a watertight test including the riser/tank connection. For detailed specifications, see structural and watertightness criteria in Orenco's *General Specifications,* NDA-DG-SPEC-1, and tank specifications checklist in Orenco's *Concrete Tank Questionnaire,* NCL-TNK-TNK-1.

**Cold Weather Considerations**

AX units are available with one inch (25 mm) of insulation attached to the bottom of the lid. Installing insulation around the sides of the filter pods themselves is optional and is done on site as needed. Other cold weather considerations include standard practices used with most onsite pump systems, such as allowing all lines to drain, insulating processing tank lids, and backfilling risers with pea gravel if frost-heave is a concern. Consult Orenco if supplementary options need to be considered.

# Standard Packages

Orenco Systems® Incorporated
800-348-9843

## AdvanTex®-AX Treatment Systems

### *Standard Package Components Supplied by Orenco Systems, Inc.*

## AX Series - Mode 1a and Mode 1a CW

PVC Splice Box
Universal Biotube Pump Vault, 57 in. typical height
Discharge Assembly
Float Switch Assembly
Orenco Pump, 115V
VCOM AdvanTex® AXA Panel, 115V
Recirc Splitter Valve Assembly
AdvanTex Filter with Vent Assembly and Antiflotation Flanges

### Accessories*

Processing Tank Equipment

## AX Series - Mode 1b and Mode 1b CW

PVC Splice Box
Universal Biotube Pump Vault, 57 in. typical height
Discharge Assembly
Float Switch Assembly
Orenco Pump, 115V
VCOM AdvanTex AXB Panel, 115V
Recirc Splitter Valve Assembly
AdvanTex Filter with Vent Assembly and Antiflotation Flanges

### Accessories*

Processing Tank Equipment
Pump Basin Equipment+Cold weather treatment systems include insulation on the lid of the AdvanTex filter, an anticondensation heater in the Control Panel, and a drainback style discharge assembly.

***Additional components provided by Orenco Systems, Inc. Processing tank and pump basin equipment varies on a case-by-case basis. Typical accessory equipment might include:***

### Processing Tank Equipment

24 in. Dia, 34 in. typical height, with lid
30 in. Dia, 34 in. typical height, with lid and necessary grommets
24 in. Dia tank adapter with bolt down kit and adhesive
30 in. Dia tank adapter with bolt down kit and adhesive

# Standard Packages (continued)

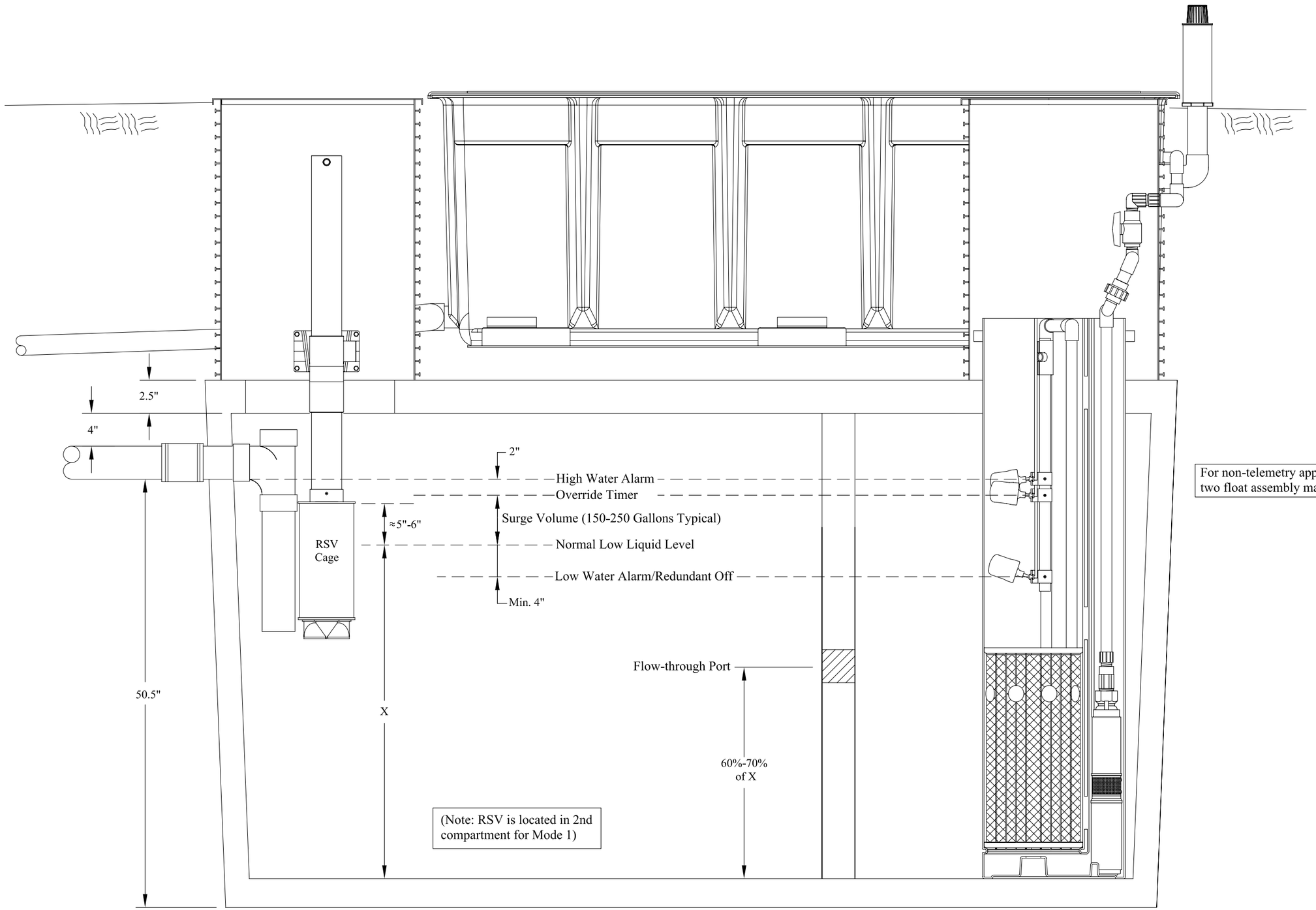
## Pump Basin Equipment

PVC Pump Basin, 24 in. Dia, 72 in. typical height with lid
PVC Splice Box
Discharge Assembly
Float Switch Assembly
Orenco Pump, 115V

## Components Not Supplied by Orenco Systems, Inc.

Processing tank
Sewer pipe from building to processing tank
External piping between tank, filter and final dispersal area
Ventilation piping
Electrical conduit and fittings
Dispersal area materials, such as rock, lateral piping, etc.

# Typical Liquid Level Positions for Residential AdvanTex® Treatment System




Orenco Systems® Incorporated

Title: Typical Liquid Level Positions for Residential AdvanTex™ Treatment System

Drawing No.

Scale: 1" = 1'-0"

Drawn By: CHRIS JORDAN

Drawing: 1 OF 1

Date: 2/14/2007

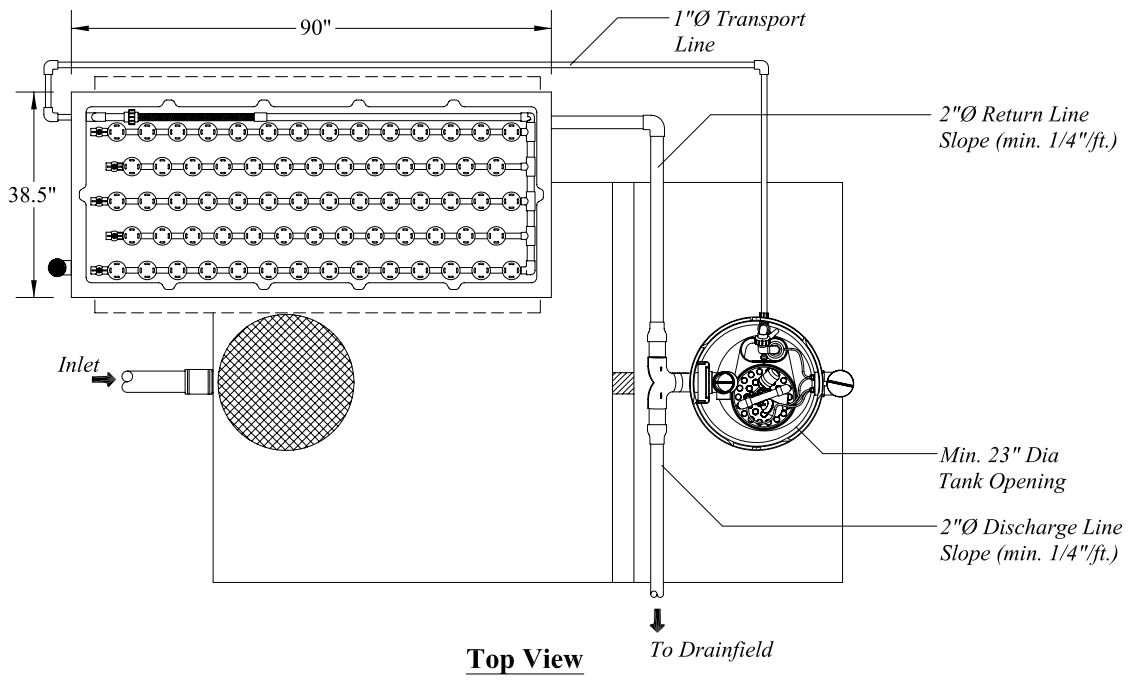
Revision: 2

Designed By: ENGINEERING

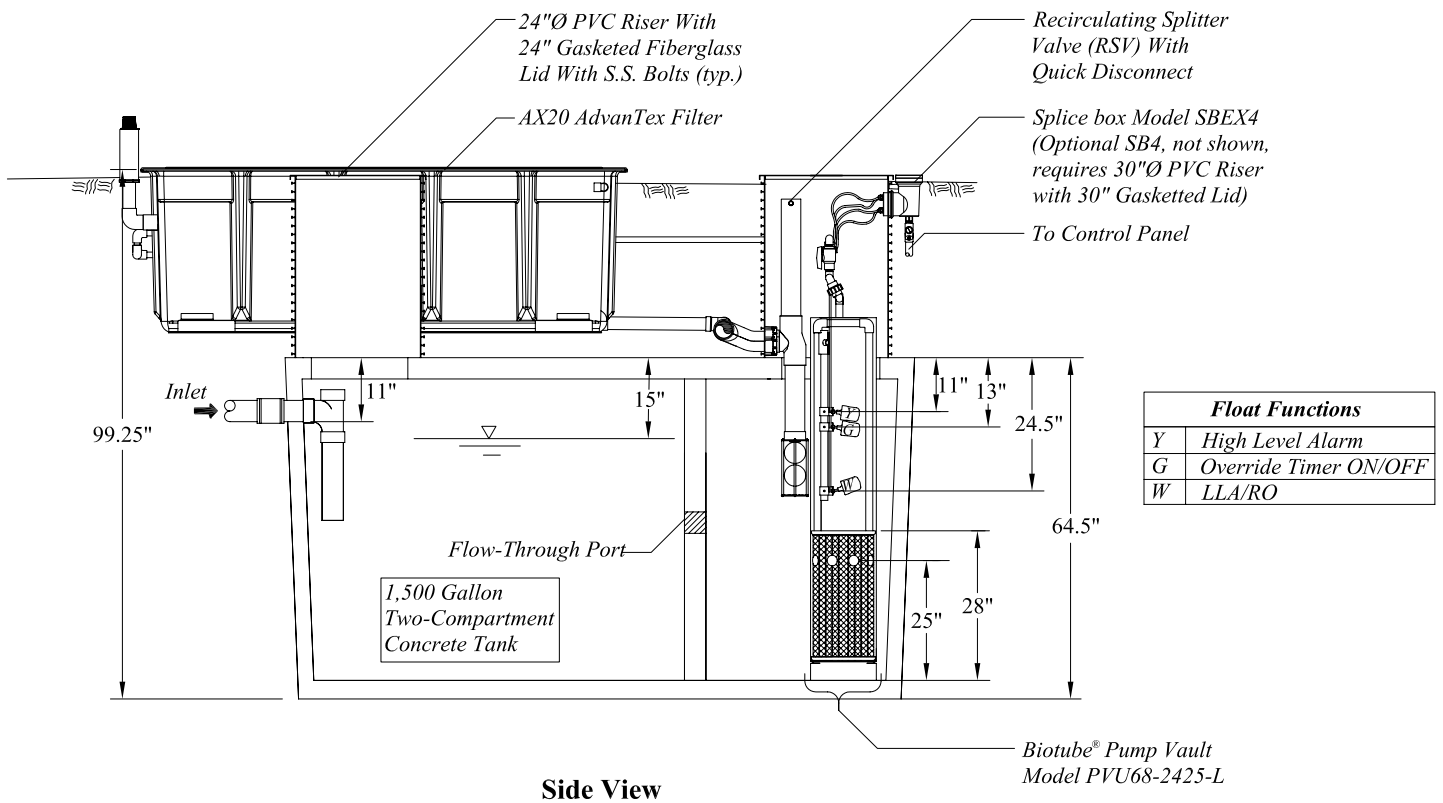
Approved By:

Date Approved:

# AdvanTex® AX20 Mode 1A w/Concrete Tank

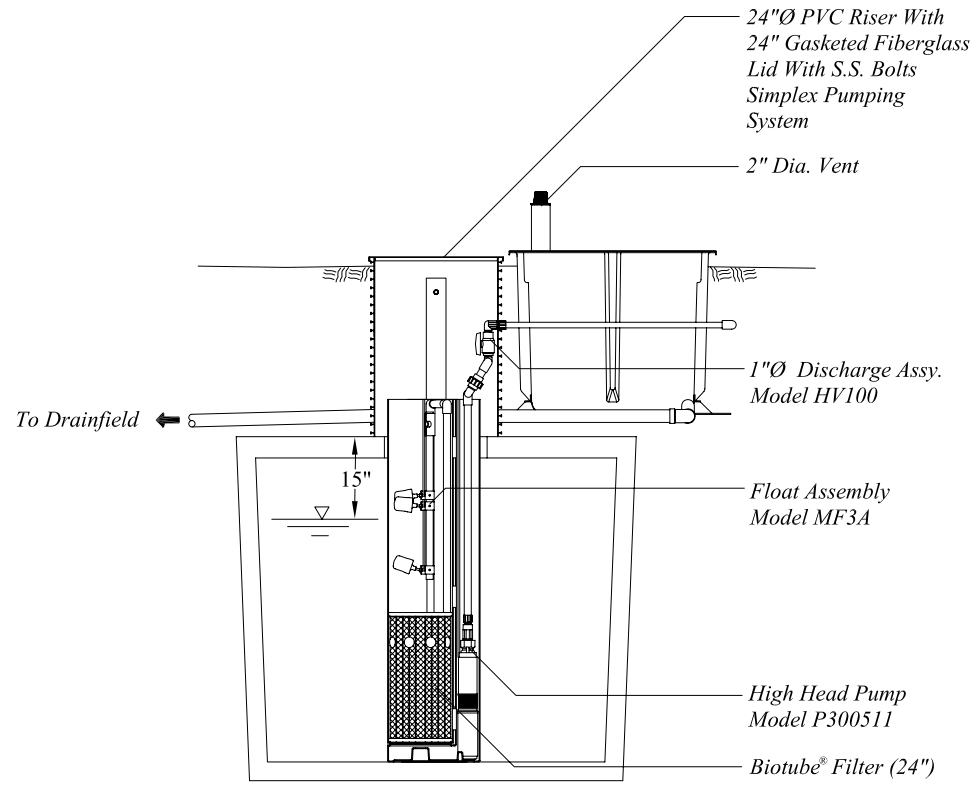



**Top View**
*Scale: 1" = 3'-0"*




| Float Functions | |
|---|---|
| Y | High Level Alarm |
| G | Override Timer ON/OFF |
| W | LLA/RO |

**Side View**
*Scale: 1" = 3'-0"*




**End View**
*Scale: 1" = 3'-0"*

## Design Notes

Expected Flows
- $Q_{Peak}$ = 500 gpd

Up To 4 Bedrooms

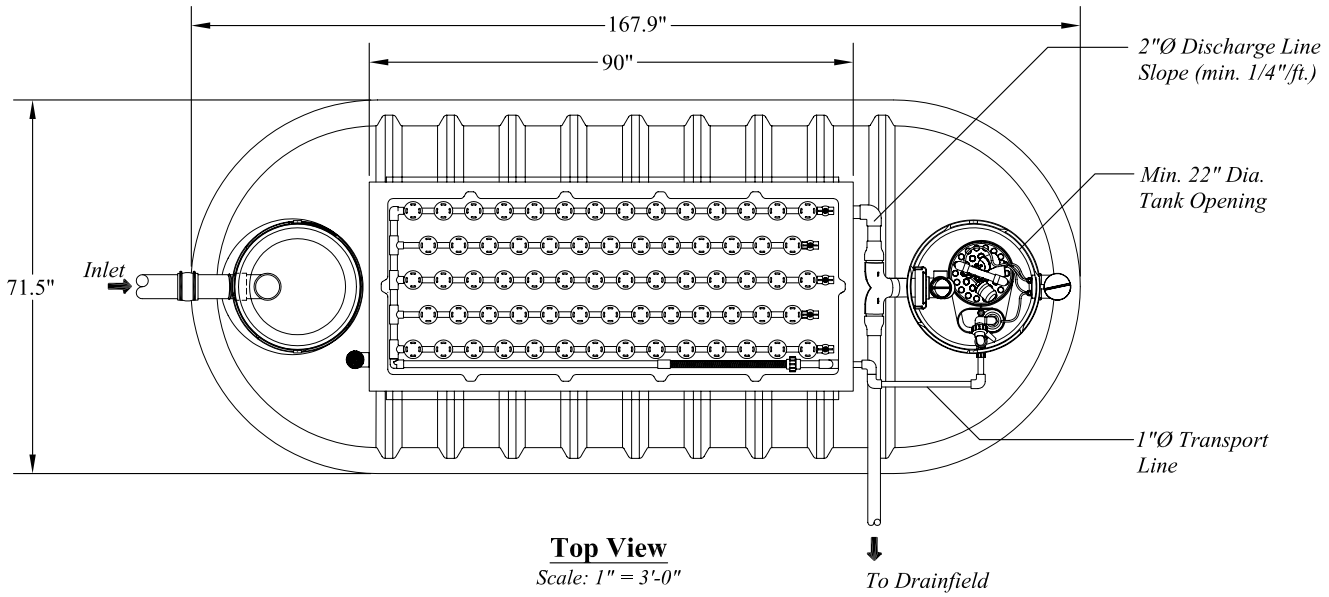
Expected Influent Quality
Grease & Oil: 20 mg/L
BOD: 150 mg/L
TSS: 40 mg/L
TKN: 65 mg/L

Typical Effluent Quality
BOD: < 10 mg/L
TSS: < 10 mg/L
TN: < 25 mg/L

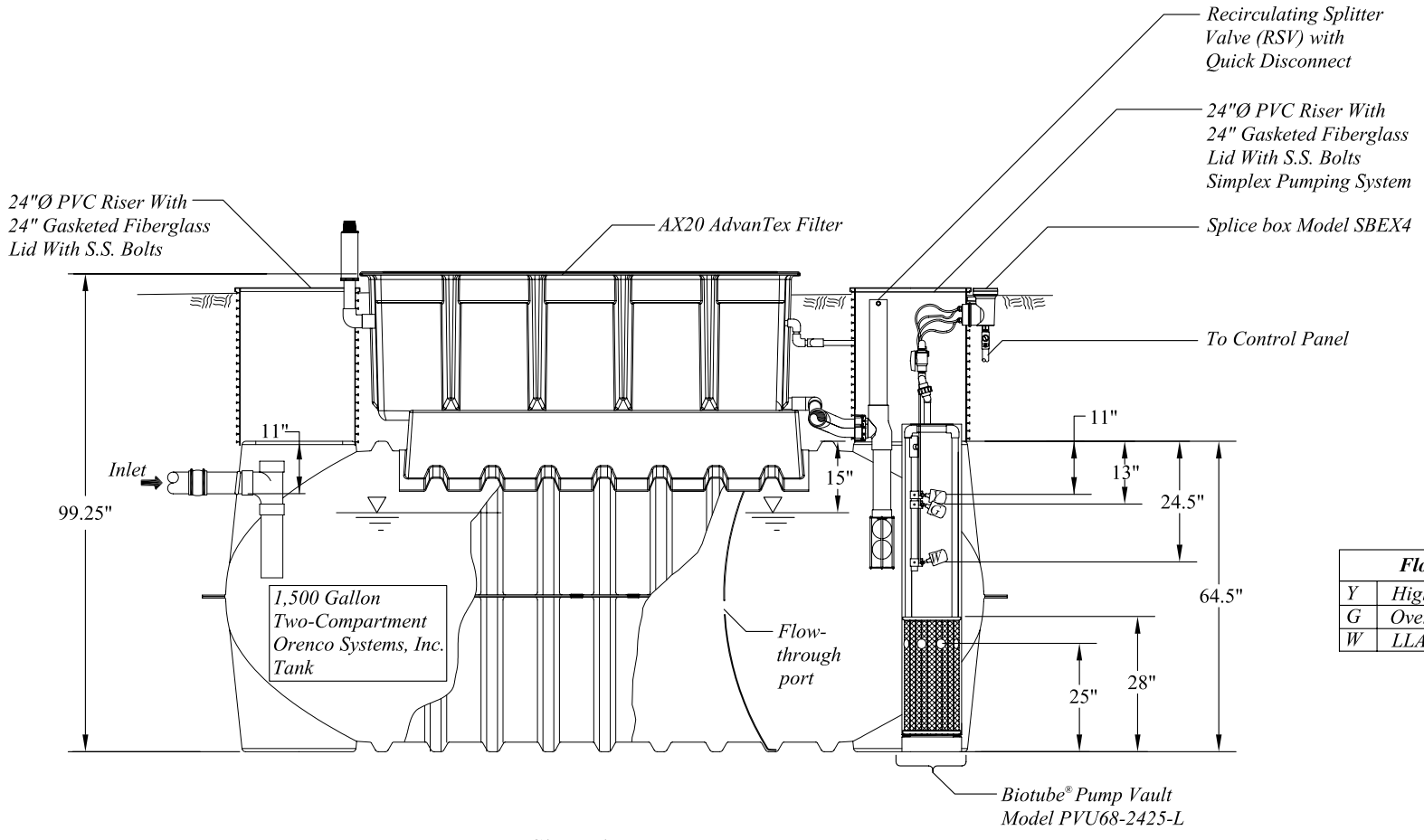
Orenco Systems® Incorporated

Title: AdvanTex® - AX20 Mode 1A
Drawing No. NDW-ATX-STD-1
Scale: 1" = 3'-0"
Drawn By: CHRIS JORDAN
Drawing: 1 OF 1
Date: 02/14/2006
Designed By: ENGINEERING
Approved By: TERRY BOUNDS PE
Revision: 2.0
Date Approved: 02/14/2006

# **AdvanTex**® AX20 Mode 1A w/Fiberglass Tank

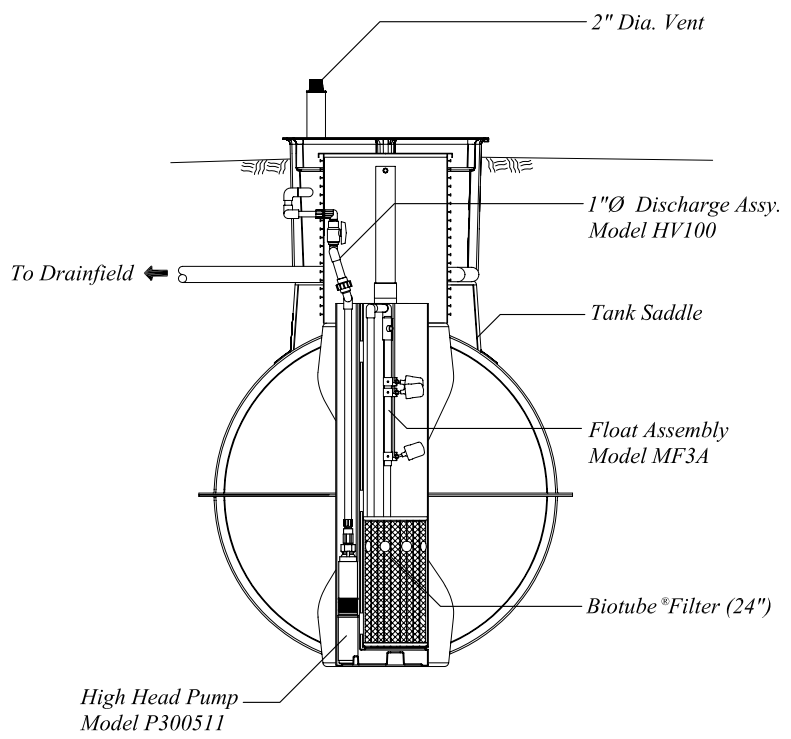



**Top View**
*Scale: 1" = 3'-0"*




**Side View**
*Scale: 1" = 3'-0"*

| ***Float Functions*** | |
|---|---|
| *Y* | *High Level Alarm* |
| *G* | *Override Timer ON/OFF* |
| *W* | *LLA/RO* |




**End View**
*Scale: 1" = 3'-0"*

## Design Notes

Expected Flows
- $Q_{Peak}$ = 500 gpd

Up To 4 Bedrooms

Expected Influent Quality
Grease & Oil: 20 mg/L
BOD: 150 mg/L
TSS: 40 mg/L
TKN: 65 mg/L

Typical Effluent Quality
BOD: < 10 mg/L
TSS: < 10 mg/L
TN: < 25 mg/L

Orenco Systems® Incorporated

Title: AdvanTex® AX20 Mode 1A

Drawing No. NDW-ATX-STD-3

Scale: 1" = 3'-0"

Drawn By: CHRIS JORDAN

Drawing: 1 OF 1

Date: 02/14/2006

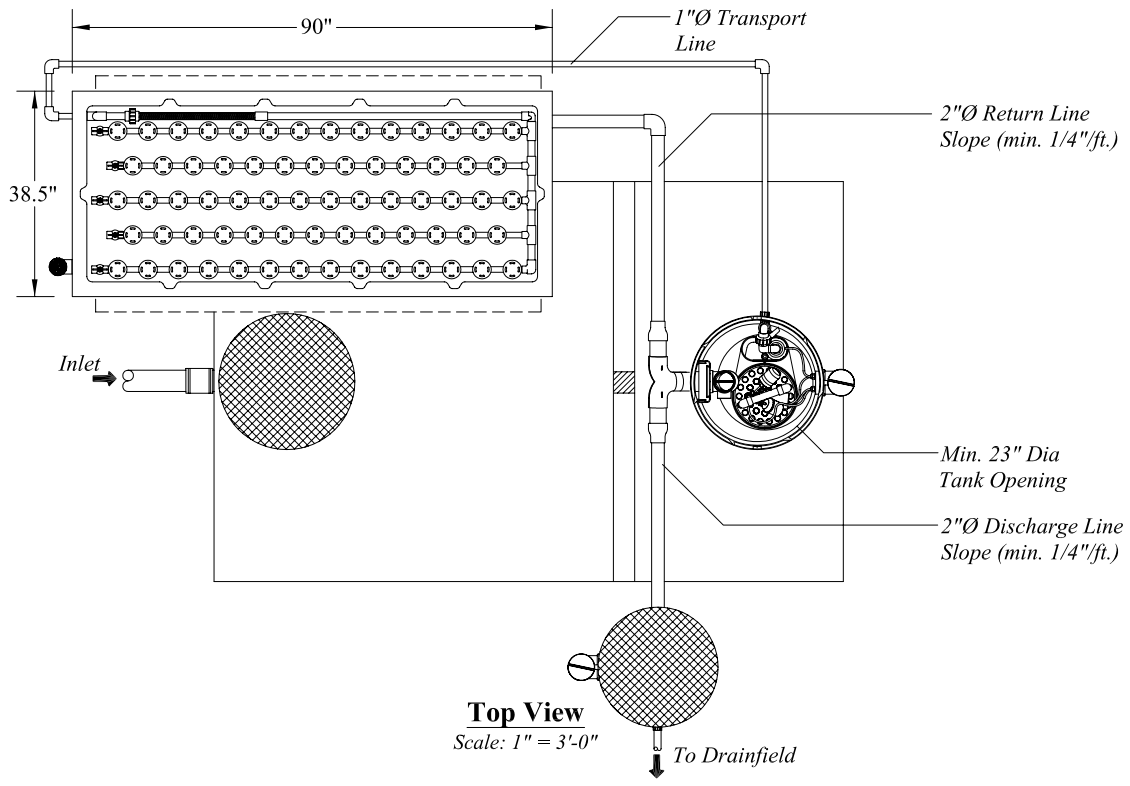
Designed By: ENGINEERING

Approved By: TERRY BOUNDS PE

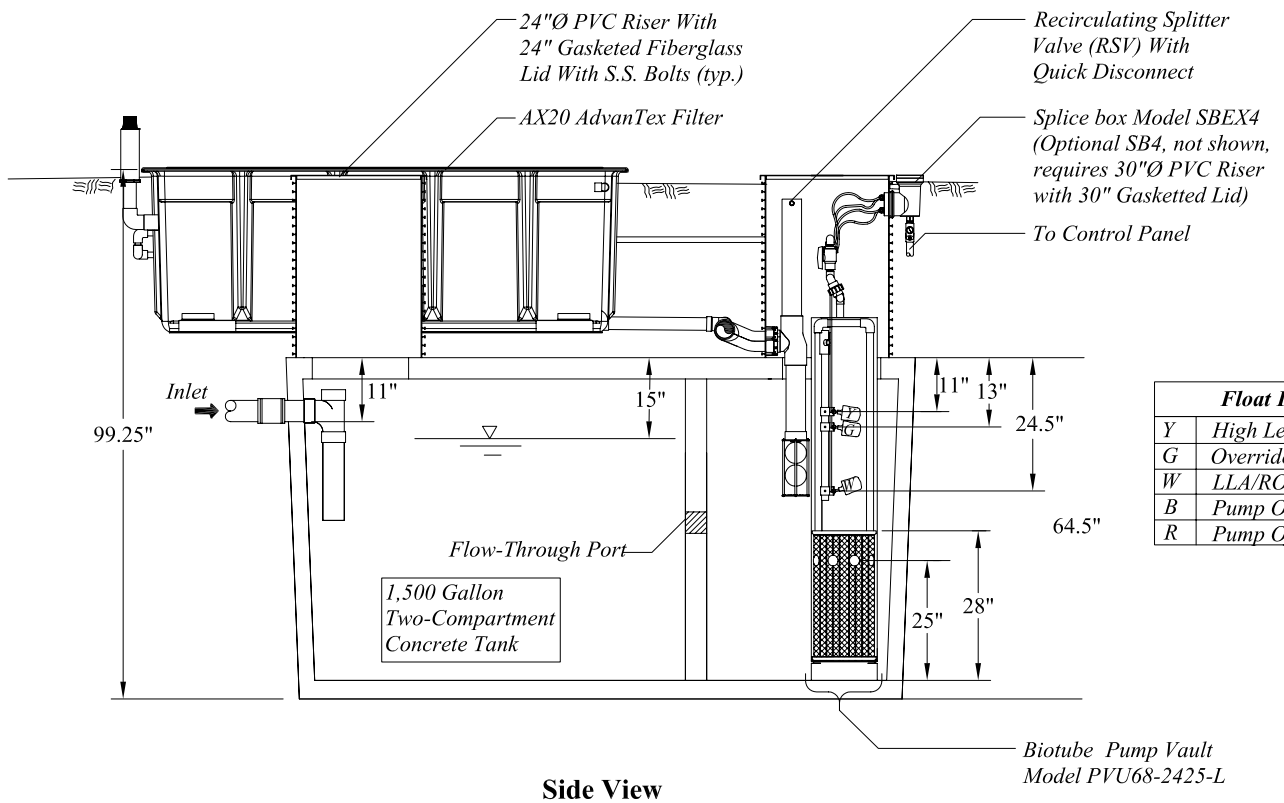
Revision: 2.0

Date Approved: 02/14/2006

# AdvanTex® AX20 Mode 1B w/Concrete Tank

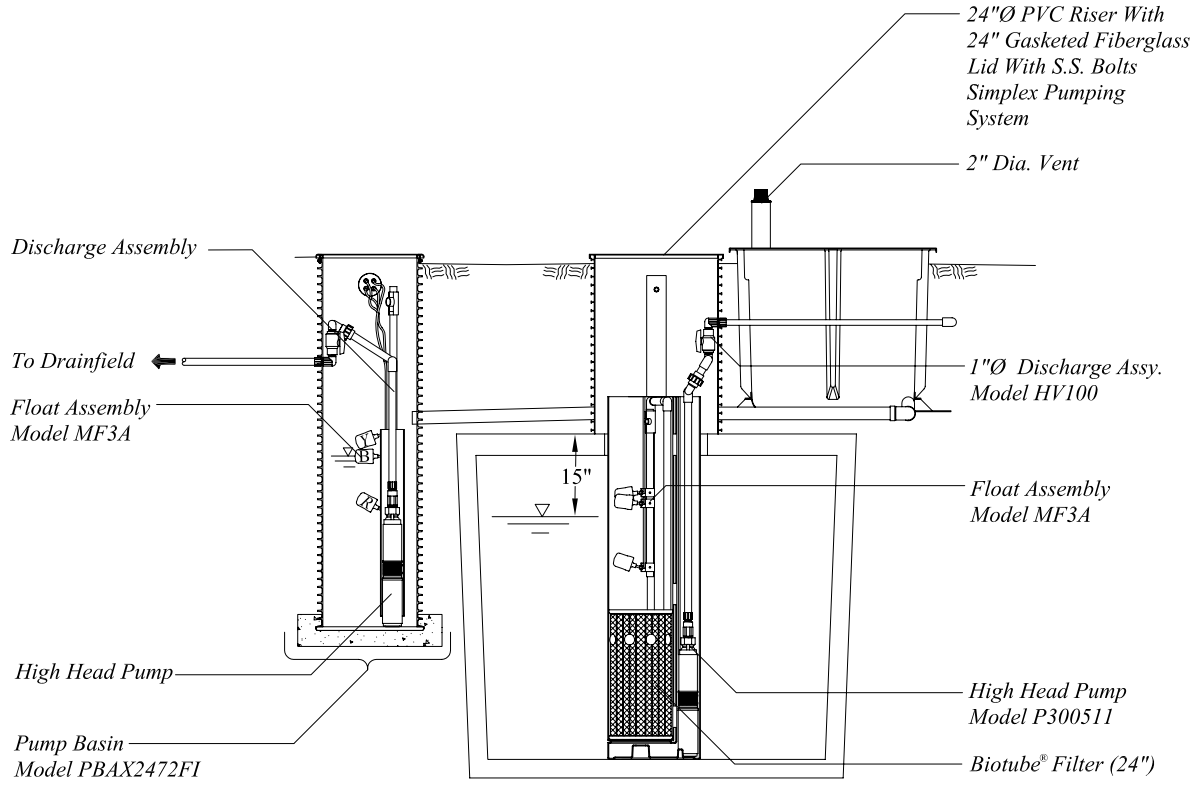



**Top View**
*Scale: 1" = 3'-0"*




**Side View**
*Scale: 1" = 3'-0"*

| Float Functions | |
|---|---|
| Y | High Level Alarm |
| G | Override Timer ON/OFF |
| W | LLA/RO |
| B | Pump On |
| R | Pump Off |




**End View**
*Scale: 1" = 3'-0"*

## Design Notes

Expected Flows
- $Q_{Peak}$ = 500 gpd

Up To 4 Bedrooms

Expected Influent Quality
Grease & Oil: 20 mg/L
BOD: 150 mg/L
TSS: 40 mg/L
TKN: 65 mg/L

Typical Effluent Quality
BOD: < 10 mg/L
TSS: < 10 mg/L
TN: < 25 mg/L

Orenco Systems® Incorporated

Title: AdvanTex® - AX20 Mode 1B

Drawing No. NDW-ATX-STD-2

Scale: 1" = 3'-0"

Drawn By: CHRIS JORDAN

Drawing: 1 OF 1

Date: 02/14/2006

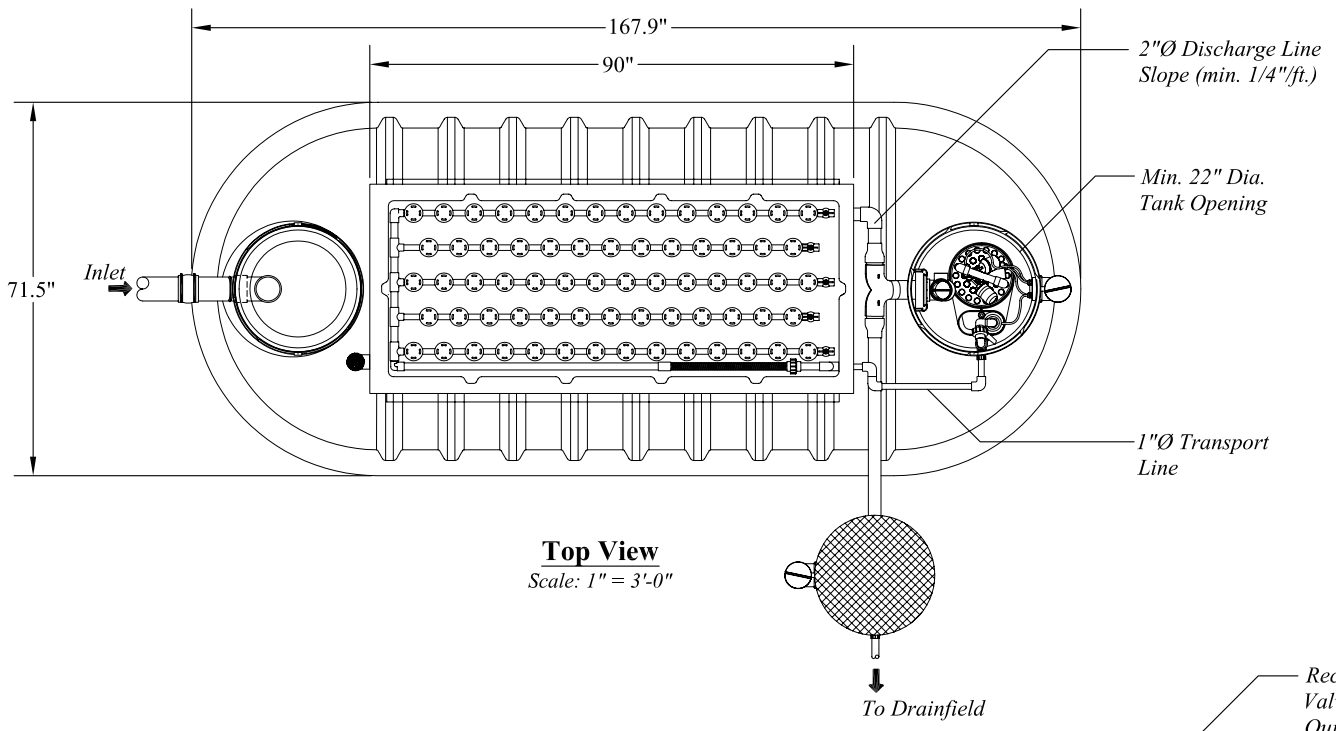
Designed By: ENGINEERING

Approved By: TERRY BOUNDS PE

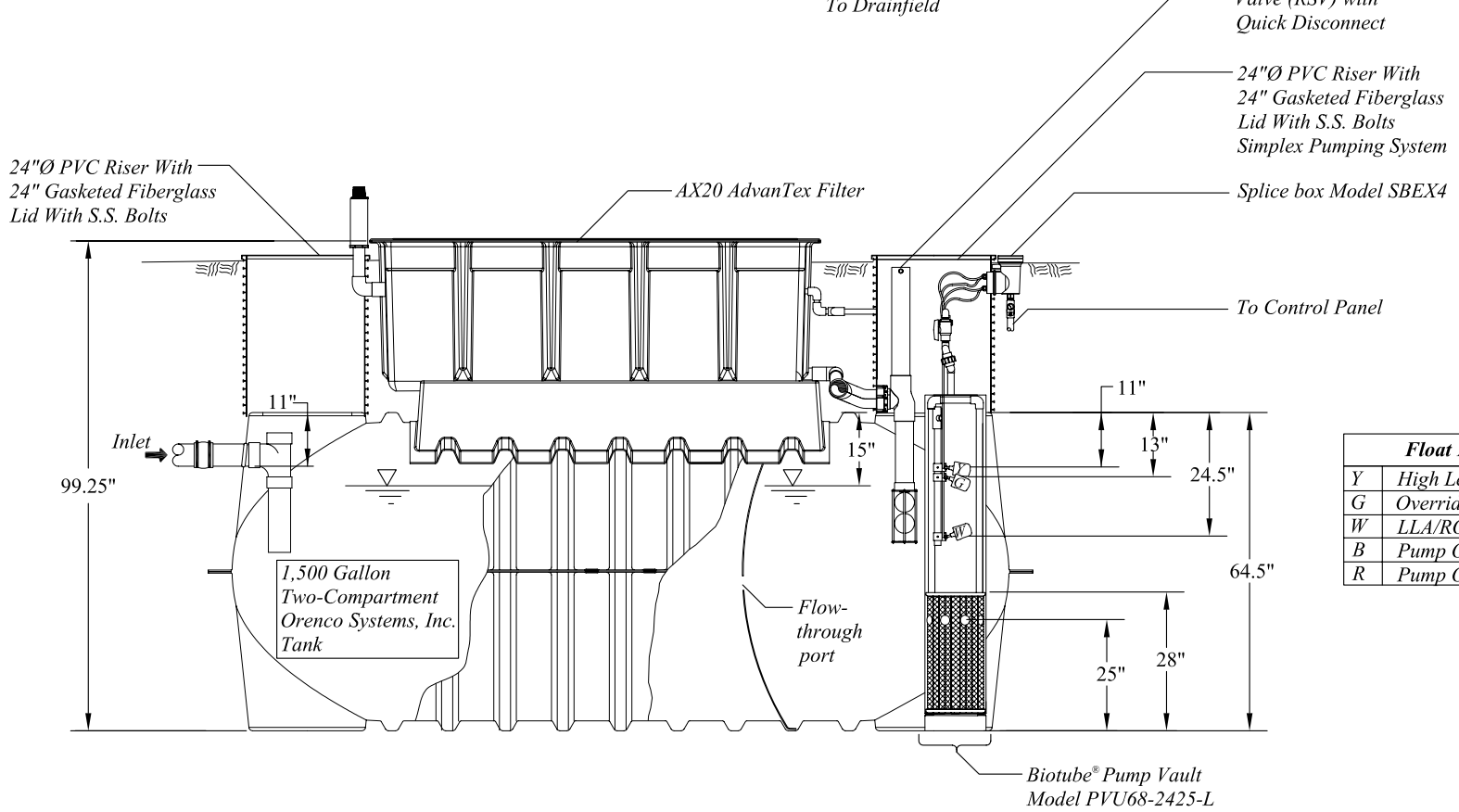
Revision: 2.0

Date Approved: 02/14/2006

# **AdvanTex**® AX20 Mode 1B w/Fiberglass Tank

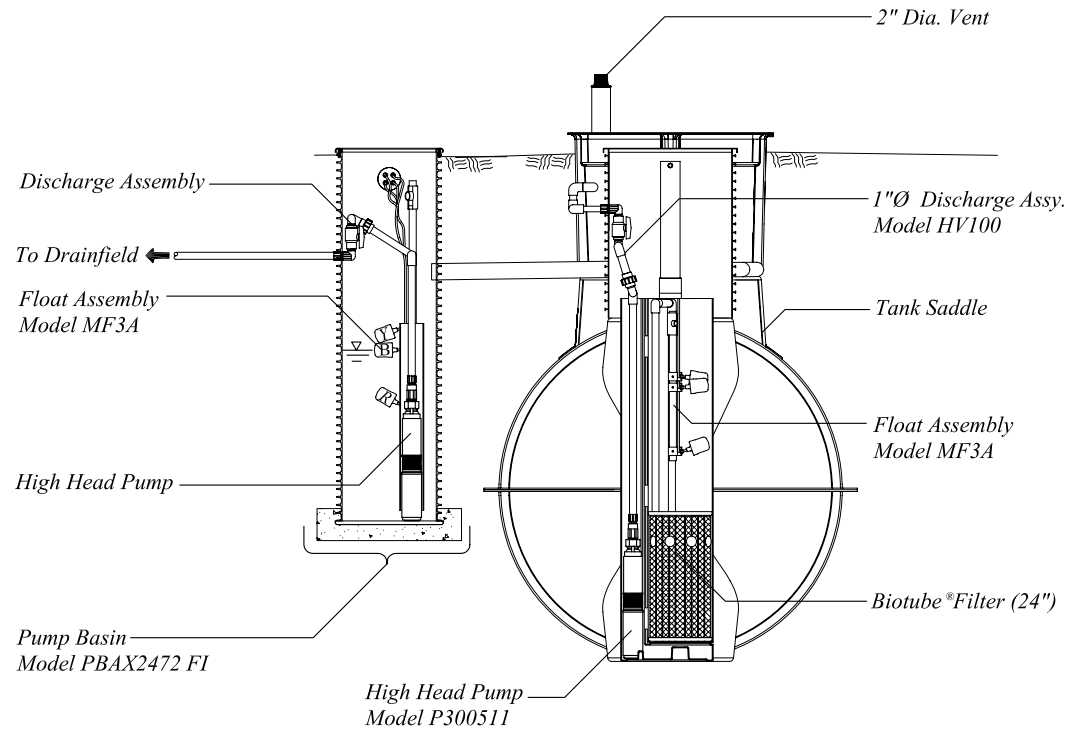



**Top View**
*Scale: 1" = 3'-0"*




**Side View**
*Scale: 1" = 3'-0"*

| *Float Functions* | |
|---|---|
| *Y* | *High Level Alarm* |
| *G* | *Override Timer ON/OFF* |
| *W* | *LLA/RO* |
| *B* | *Pump On* |
| *R* | *Pump Off* |




**End View**
*Scale: 1" = 3'-0"*

## Design Notes

Expected Flows
- $Q_{Peak}$ = 500 gpd

Up To 4 Bedrooms

Expected Influent Quality
Grease & Oil: 20 mg/L
BOD: 150 mg/L
TSS: 40 mg/L
TKN: 65 mg/L

Typical Effluent Quality
BOD: < 10 mg/L
TSS: < 10 mg/L
TN: < 25 mg/L

Orenco Systems® Incorporated

Title: AdvanTex® AX20 Mode 1B
Drawing No. NDW-ATX-STD-4
Scale: 1" = 3'-0"
Drawn By: CHRIS JORDAN
Drawing: 1 OF 1
Designed By: ENGINEERING
Approved By: TERRY BOUNDS PE
Revision: 2.0
Date: 02/15/2006
Date Approved: 02/15/2006

# Homeowner Worksheet

Orenco Systems®
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800-348-9843

## Choosing a Wastewater Treatment System

If you're like most homeowners, you're probably unfamiliar with wastewater treatment systems. And that's not surprising. After all, how often do you ever choose one? Maybe once or twice in a lifetime?

From our headquarters near Roseburg, Oregon, we at Orenco Systems have been educating homeowners, wholesalers, installers, operators, regulators, builders, and real estate agents about wastewater treatment systems for the past 25 years. Here are some questions that every homeowner should ask before choosing a system:

- ***NOISE***
  How noisy is the system? Will it keep me awake at night?
- ***ODOR***
  Does the system have a reputation for being smelly? For foaming up and out of the tank?
- ***ELECTRICITY COST***
  How much will the electricity cost me, each and every month, to run the system?
- ***VISUAL IMPACT***
  What am I going to see in my back yard? How much of my yard will the system take up?
- ***RELIABLE PERFORMANCE***
  Will my system work properly and reliably, even when I'm using it a lot? (For example, when I'm doing laundry or entertaining guests.) How about when I'm not using it enough? (For example, when I go on vacation.)
- ***ALARMS***
  If something goes wrong with the system, do I have to stop what I'm doing? Do I have to handle the alarm? What if I'm not home? Can the system automatically notify a Service Provider? Can the Service Provider handle alarms from his or her computer, without making a costly service call?
- ***ALERTS***
  If I'm using more water than my system is designed to handle (for example, if a toilet valve gets stuck), does my system have some kind of a quiet "early-warning signal"?
- ***MAINTENANCE COSTS AND SERVICEABILITY***
  How many service calls does the system typically require in any given year? How often will the system have to be pumped and how much will that cost? Are the system and its components easy for service providers to reach and clean?
- ***EQUIPMENT REPLACEMENT COSTS***
  Are there components in the system (such as pumps, controls, blowers, or aerators) that will have to be replaced within a few years? What are the repair/replacement costs for those components? How long is the warranty for those replacement components?
- ***WARRANTIES***
  How long is the warranty for the treatment system?



*(Worksheet on back)*

| | Orenco AdvanTex® Filter | Orenco Sand Filter | Activated Sludge (aka "Aerobics" or "ATU") | Fill In: |
|---|---|---|---|---|
| **Noise** | Occasional clicking from control panel, so panel should be mounted on a post, not a wall. | Occasional clicking from control panel, so panel should be mounted on a post, not a wall. | Noisy external blower or aerator runs 24 hours/day. | |
| **Odor** | Not typical | Not typical | Some is typical | |
| **Electricity Cost** | $1.00/mo* | $0.25/mo* | $15.00-40.00/mo* | |
| **Visual Impact** | System footprint typically measures 75 $ft^2$. Control panel on post plus four ground-level lids. | System footprint typically measures 440 $ft^2$. Control panel on post, three ground-level lids, and 4-15 valve box lids. | System footrpint similar to AdvanTex. Control panel on post, 3-4 ground-level lids, and above-ground housing for blower or aerator. | |
| **Reliable Performance** | System can handle all normal household uses. | System can typically handle all normal household uses, depending on tankage and control panel. | System not found to work reliably with heavy use or low use. During heavy use, wastewater runs quickly through the system because of its "gravity-in, gravity-out" setup. After low use, restart can shock the system. In both cases, untreated or partially treated waste can flow to the drainfield. | |
| **Alarms** | Alarm transmitted automatically to contracted Service Provider, who can often adjust system remotely, via a phone connection.<br>24-48 hour reserve capacity in tank (depending on usage), so system still usable. | Homeowner must turn alarm off and find/call a Service Provider.<br>24-48 hour reserve capacity in tank (depending on usage), so system still usable. | Homeowner must turn off alarm and call Service Provider. | |
| **Alerts** | Monitoring system quietly alerts service provider via e-mail of excessive water use, preventing future problems. | No quiet alert for excessive water use, but audible alarms available. | Not available. | |
| **Maintenance Costs and Serviceability** | Two service calls in first year. Annual service call thereafter.†<br>8-12 year pumping interval (assumes 3-4 occupants, 1,000-gal primary chamber).<br>At-grade installation of treatment unit for ease of servicing all components and media. | Annual service call.<br>8-12 year pumping interval (assumes 3-4 occupants, 1,000-gal tank).<br>At-grade installation of treatment unit. Easy servicing of components but not media. | Two service calls per year.<br>6-month servicing interval for all air filters.<br>3-6 month pumping interval.‡<br>Below-grade installation of treatment unit makes servicing of all components difficult. | |
| **Equipment Replacement Costs** | Expected pump life and controls life of 20+ years.<br>No blowers or aerators to replace. | Expected pump life and controls life of 20+ years.<br>No blowers or aerators to replace. | 6-month life cycle on air filters.<br>Expected 3-5 year life cycle on blower or aerator.§ | |
| **Warranties** | Varies by region, but is at least 3 years on complete system. | 1-year warranty on treatment system components, 3-year warranty on control panel. | Varies; typically 2-year warranty on parts. | |
| **Value-Added Features** | In addition to Treatment System, package includes:<br>Control Panel:<br>☐ Alarm only<br>☐ Alarm, timers<br>☑ Alarm, timers, and telemetry (to communicate with Service Provider)<br>Tankage:<br>☐ Yes (_____ gal) ☐ No<br>Discharge Basin:<br>☐ Yes ☐ No | In addition to Treatment System, package includes:<br>Control Panel:<br>☐ Alarm only<br>☑ Alarm, timers<br>☐ Alarm, timers, and telemetry (to communicate with Service Provider)<br>Tankage:<br>☐ Yes (_____ gal) ☐ No<br>Discharge Basin:<br>☐ Yes ☐ No | In addition to Treatment System, package includes:<br>Control Panel:<br>☐ Alarm only<br>☐ Alarm, timers<br>☐ Alarm, timers, and telemetry (to communicate with Service Provider)<br>Tankage:<br>☐ Yes (_____ gal) ☐ No<br>Discharge Basin:<br>☐ Yes ☐ No | In addition to Treatment System, package includes:<br>Control Panel:<br>☐ Alarm only<br>☐ Alarm, timers<br>☐ Alarm, timers, and telemetry (to communicate with Service Provider)<br>Tankage:<br>☐ Yes (_____ gal) ☐ No<br>Discharge Basin:<br>☐ Yes ☐ No |

* Based on national averages for $/kWh ($0.08) and occupants (3). Assumes single pump or blower/aerator. Assumes pump run time of 20 min/day for AdvanTex, 4.5 minutes per day for sand filter, and blower/aerator run time of 24 hours/day for ATUs.

† For non-NSF models. NSF models have two service calls per year in first two years.

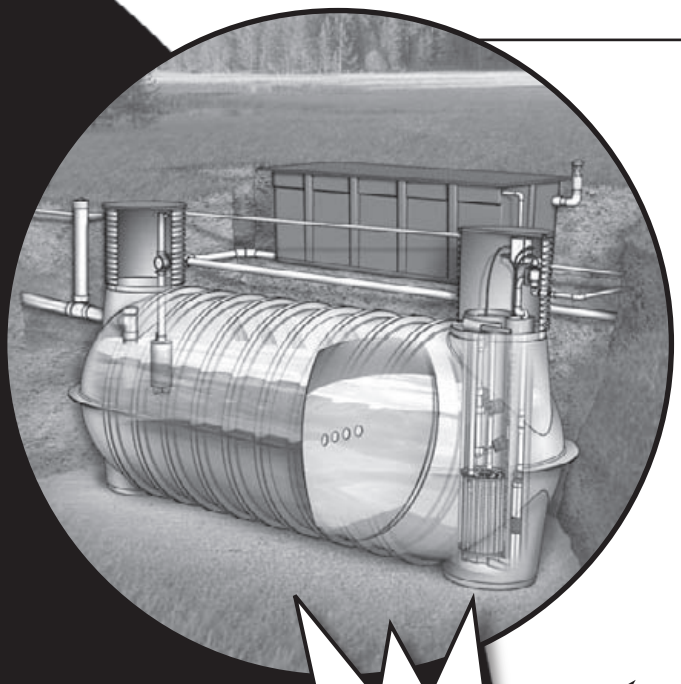
‡ Based on U.S. EPA's Onsite Wastwater Treatment Manual, TFS-2 (chart)

§ ibid, p. 4-55, "4.8.6. Costs"

# Installation Guide

## AdvanTex®-AX Treatment Systems

### *Residential Applications*



***An illustrated step-by-step guide for installing an Orenco Systems AdvanTex® Treatment System in a residential application.***

**New! Install Video Now Available! Call Your Dealer**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**NIM-ATX-AX-1**
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**Orenco Systems®, Inc.**

# Installation Guide: *Residential AdvanTex® Systems*

# Installation Guide: *Residential AdvanTex® Systems*

## *Before You Begin*

As the installer of an onsite wastewater treatment system, you play a crucial role. Dealers, regulators, homeowners, manufacturers, neighbors, service providers...we all rely on your expertise and good work. At Orenco, we've worked hard to make your installation as easy and "hassle-free" as possible.

*Property owners, neighbors, regulators, dealers, manufacturers, and service providers all depend on your careful installation.*

We're very proud of this wastewater treatment system. Like all our products, the AdvanTex® Treatment System has gone through extensive research, development, and field-testing. Then each component is built to written specifications and subjected to quality review before shipping. In addition, our AXN models meet the requirements of NSF-ANSI Standard 40 for Class I Systems. If this system or any of its components possesses flaws that would inhibit its proper functioning, please contact your authorized AdvanTex Dealer. The Dealer can also provide repair and replacement instructions and replacement components. If there is no authorized AdvanTex Dealer in your area, call Orenco Systems, Inc. at 800-348-9843.

This manual covers installation of all residential models of our AdvanTex Treatment Systems, including Mode 1 and Mode 3 configurations. If you're unsure which mode you are installing, check the design drawing. It's important that you read through this entire manual before doing anything.

In addition, the installation manual for the system's electrical control panel describes installation, wiring, timer settings, and operating instructions for Orenco control panels. Please read all control panel documentation, as well.

Also, be sure to get a copy of our AX20 Install Video from your AdvanTex Dealer. Watching the video will help you understand the installation process. However, please note that the manual contains more detail and is updated more often than the video, and *you must perform the installation according to the current manual to keep the warranty in force*.

Once you become familiar with the installation process, you should be able to install an AdvanTex filter in half a day, not counting the time to install the tank and dispersal system.

## Important Notes

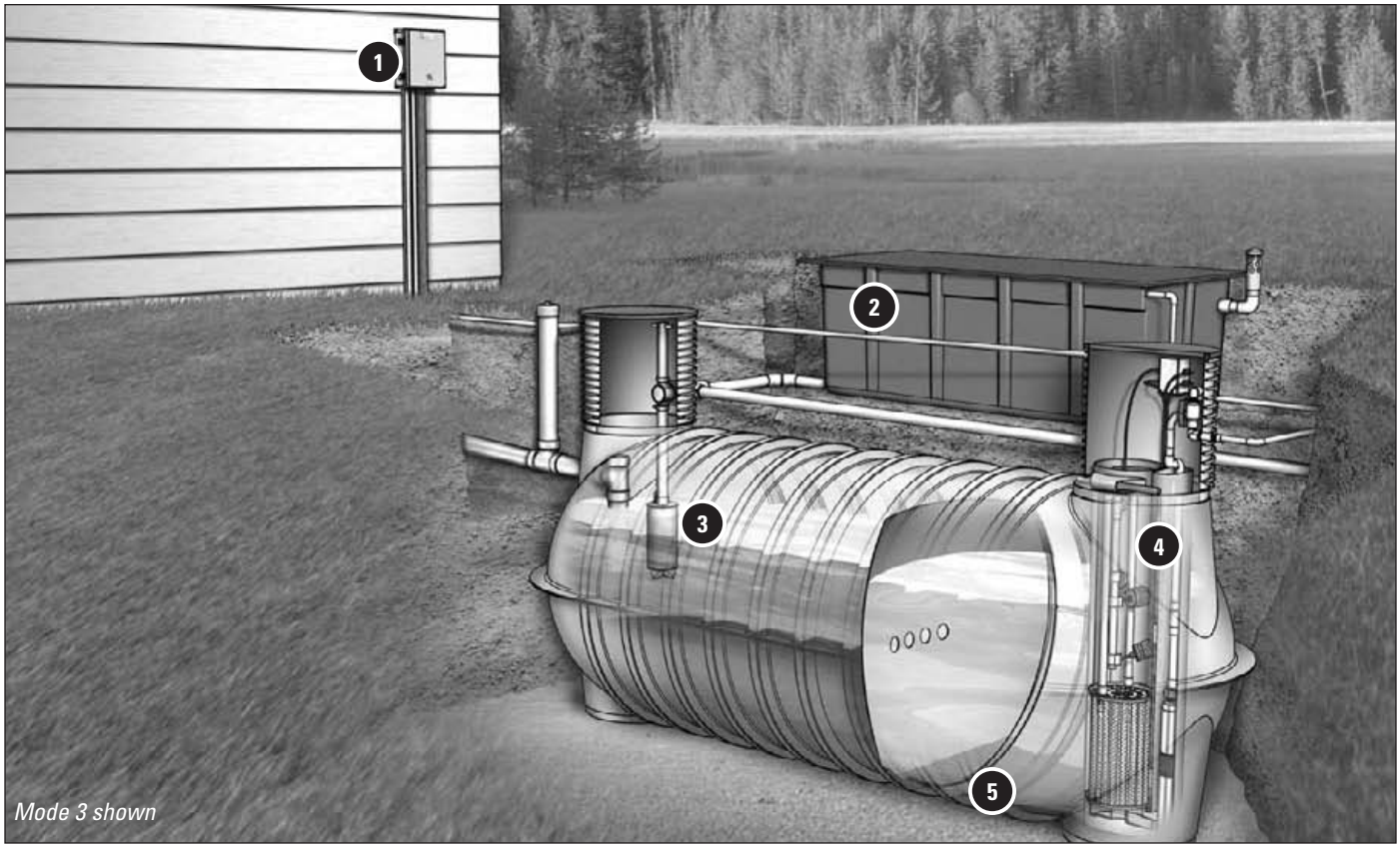
- *All tanks used with AdvanTex Treatment Systems must be prequalified. Call your local Dealer for specifics.*
- *The backwash discharge from a salt-type water softener must not be plumbed into an AdvanTex Treatment System, or the system's warranty will be void. Contact your AdvanTex Dealer if you have any questions about household plumbing arrangements that may interfere with the functioning of the system.*
- *All pipe diameters given are U.S. nominal IPS pipe sizes. If you are using metric pipe, you may need adapters to connect to the U.S. fittings supplied.*

# Installation Guide: *Residential AdvanTex® Systems*

## *Overview*

The AdvanTex Treatment System has five main functional units:

1. Control Panel
2. AdvanTex Filter Pod
3. Recirculating Splitter Valve
4. Biotube® Pumping Package
5. Processing Tank



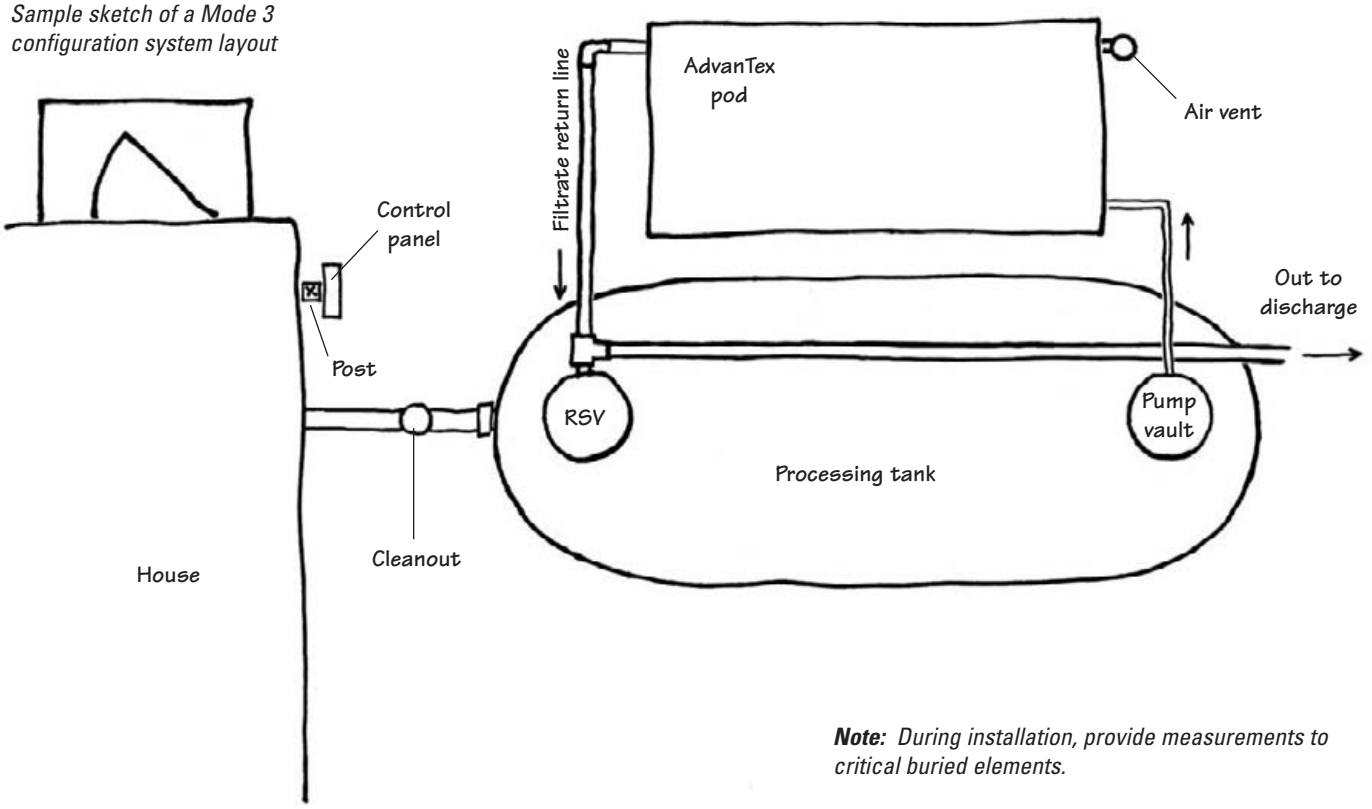

Raw sewage enters the two-compartment processing tank through its inlet tee. In the first compartment, the raw sewage separates into three distinct zones: a scum layer, a sludge layer, and a clear layer. Holes in the tank's baffle wall allow effluent from the clear layer to flow into the second compartment of the tank. The Biotube pump package in the second compartment pumps filtered effluent to a distribution manifold in the AdvanTex pod. Effluent percolates down through the textile media and is collected in the bottom of the filter basin. The treated effluent flows out of the filter basin through a 2-in. diameter pipe that returns the treated effluent to the recirculating splitter valve (RSV). The RSV automatically splits the return flow between the processing tank and the final discharge. The RSV also controls the liquid level within the processing tank. During extended periods of no flow, 100% of the treated effluent is returned to the processing tank.

The operation of the pump in the second compartment is controlled by a programmable timer in the control panel, which allows the pump to dose the filter for short periods (usually a half-minute or less), typically 72 times a day. This frequent "microdosing," which optimizes the treatment process, occurs 24 hours a day, to maintain the proper biological environment.

## *Step 1: Determine Tank and AdvanTex Pod Positions*

Sketch exact positions of the processing tank and AdvanTex pod on the site. Also, sketch placement of the control panel (see the control panel's installation manual for details). The AdvanTex pod can be placed in several different positions in relation to the processing tank. Before determining which position is best, look to see how the filtrate return line needs to be run. Note that the 2-in. diameter outlet coupling for the filtrate return line and the 1-in. diameter inlet coupling for the transport pipe are typically installed in opposite corners of the AdvanTex pod, forming a diagonal across the pod.

*Sample sketch of a Mode 3 configuration system layout*




***Note:*** *During installation, provide measurements to critical buried elements.*

***NOTE:*** *Be sure to position the tank and the AdvanTex pod so that there is at least a 1-1/2-in. (38-mm) drop in the line from the outlet at the bottom of the pod to the inlet of the RSV.*

For multipod residential systems, contact your local Dealer for special instructions on layout, installation, and equipment.

## *Step 2: Excavate Site and Set Tank*

**Step 2a:** Before excavating, consider the elevations required for the tank and AdvanTex pod. The AdvanTex pod must be elevated high enough above the tank to allow for a minimum 1/4 in. per foot slope (20 mm per meter, or a 2% slope) in the filtrate return line, which runs from the outlet of the filter to the inlet of the RSV.

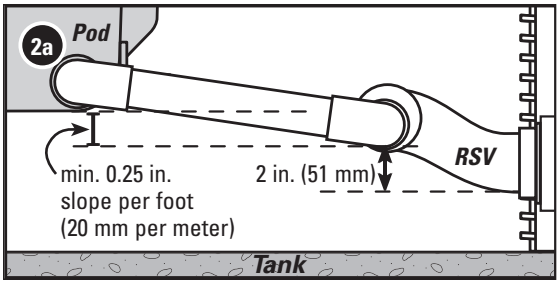
Using an Orenco Fiberglass Tank with Tank Saddle will create the correct slope. If a concrete tank is used or if an Orenco Fiberglass Tank without a Tank Saddle is used, you need to calculate how high to elevate the pod above the tank. Variables that affect this height are the length of the filtrate return line, the type of tank used, the style of the tank adapter, and the elevation of the RSV3Q penetration in the riser.

**Step 2b:** Another consideration is that the top of the AdvanTex pod should end up approximately 1-1/2 in. (38 mm) above finished grade, to allow for settlement and drainage. Take into account any planned landscaping that might affect the finished grade of the system.

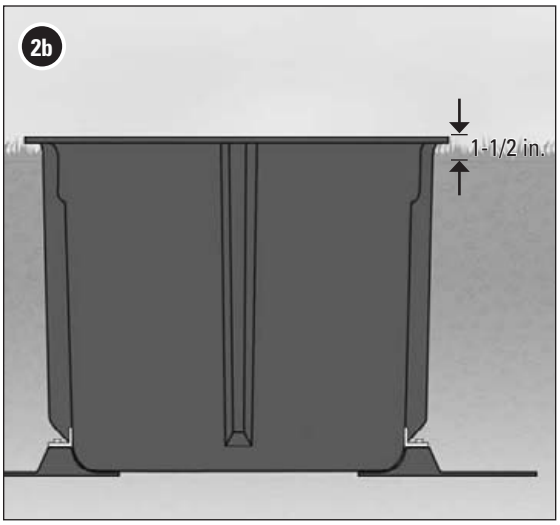
**Step 2c:** Outline an excavation area (with chalk, paint, string, etc.) for both the tank and AdvanTex pod. Excavate the hole for the tank per the tank manufacturer's recommendations. If the pod will be installed in its own hole instead of on top of the tank, make the hole at least 5 ft × 9-1/2 ft (1500 mm × 2900 mm) to accommodate the antiflotation flanges. For multipod systems, make sure you allow at least 44 in. (1118 mm) between each pod.

If your system will include a discharge pump basin (Modes 1B and 3B), you will need a hole for that, too. You can dig it when you dig the main hole, or later. Refer to Appendix 4 of this document for information about installing the pump basin.

**Step 2d:** Excavate to the proper depths as determined above for proper elevations. Make sure the bottom of the excavation is free of debris, especially rocks and other sharp objects. If the bottom of the excavation is uneven or rocky, lay a 3-in. (76 mm) bed of sand or pea gravel and compact the material to create an even, smooth surface.




*Calculate the height of the pod above the tank based on the designed length of your filtrate return line and the installed height of your RSV above the tank.*




*The AdvanTex pod's lid should be 1-1/2 in. (38 mm) above finished grade*


**Step 2e:** Follow the tank manufacturer's guidelines for setting the tank. If you are installing the AdvanTex pod over the top of the tank, follow the tank manufacturer's guidelines for watertight testing, antiflotation measures, and backfilling before proceeding with the AdvanTex installation.

***NOTE:*** *An AdvanTex pod can be attached to an Orenco FRP tank using the Fiberglass Tank Saddle (AX-SADDLE). Consult the Fiberglass Tank Saddle Installation Instructions (NIN-SAD-1), available from the Document Library at www.orenco.com. Some Dealers supply the pod already attached and plumbed so that the tank and pod can be installed as a unit, as shown in the illustration at left.*

**Step 2f:** If you are using a pump basin, set it in its excavation and level it. Make sure the top of the pump basin matches the levels of the other riser lids, and be sure to orient the pump basin so that the grommets face in the correct directions, as shown on the site plan.

## *Step 3: Install Risers and Water Test Tank*

***NOTE:*** *The External Splice Box (if one is used) and the bracket for the Recirculating Splitter Valve (RSV) should be installed on the riser before the riser is mounted. The Dealer typically installs these components before delivering the riser. If you need to install an External Splice Box or RSV bracket, refer to the instructions that come with them. If an Internal Splice Box is supplied instead, follow the instructions in Step 7c to install it after the riser is in place.*

**Step 3a:** Refer to the Riser Sizing Chart at right to ensure you are installing the right size risers for your application. Orient risers with grommeted holes in the directions shown on your engineering plans. The riser that will have the RSV installed in it (inlet riser for Mode 3; outlet riser for Mode 1) must be installed so that the RSV inlet piping is oriented to accept the filtrate return line. For any risers that will have electrical conduits running to them, try to orient electrical grommeted holes to minimize the number of bends. (National Electrical Code limits the sum of all bends in a run to 360 degrees.)

**Step 3b:** Wipe the areas to be bonded with a clean rag to ensure a clean, dry bonding surface.

**Step 3c:** There are several methods of applying adhesive to the outside and inside of the riser tank adapter.* You can use ADH100 or methacrylate adhesive alone. However, because ADH100 does not provide a structural joint for approximately 24 hours and may therefore delay installation and backfilling, you may want to use both adhesives. If so, apply methacrylate adhesive to the outside surface of the riser tank adapter for a quick (usually an hour or less) structural joint.

*External splice box*

*RSV bracket*

*Internal splice box*

### *Riser Sizing and Tank Opening Chart*

| | Mode 1 | Mode 3 |
|---|---|---|
| **Inlet riser** | 24 in. (610 mm) | 24 in. (610 mm) |
| **Inlet tank opening** | 20 in. (508 mm) | 20 in. (508 mm) |
| **Outlet riser** | 30 in. (762 mm)* | 24 in. (610 mm) |
| **Outlet tank opening** | 23 in. (584 mm) | 20 in. (508 mm) |

** Using the External Splice Box allows use of a 24-in. outlet riser.*


*Methacrylate adhesive*


** Orenco FRP tanks do not require an adapter. Risers are bonded directly to the tank.*


*Apply bead of adhesive under RSV bracket*


*ADH100 adhesive*

**Step 3d:** When applying adhesive to the riser with the RSV, apply an additional bead below the RSV bracket before placing the riser on the manway, because once the riser is in position, it is hard to reach under the RSV bracket with an adhesive gun.

**Step 3e:** Carefully slide the riser onto the adapter. Correctly orient the riser before the adhesive starts to set.

**Step 3f:** If you are using both types of adhesive, apply a bead of ADH100 adhesive to the inside of the adapter and riser joint. Use a tongue depressor or similar tool to form a continuous fillet between the tank adapter and the inside of the riser.

**Step 3g:** After the adhesives have hardened, fill the tank with clean water to a level 2 in. (51 mm) above the adhesive joint in the riser, to test the watertightness of the tank and the riser joint. Do not allow the water level to rise more than 3 in. (76 mm) into the riser because structural damage to the tank may occur. The inlet pipe into the tank needs to be turned up or plugged to allow the tank to be filled.

***CAUTION:*** *Check the tank manufacturer's guidelines before filling the tanks. Some tank manufacturers require a partial or complete backfill before a tank is filled.*

**Step 3h:** When the tank proves watertight, pull the inlet plug to drain the excess water.

## *Step 4: Set AdvanTex Pod*

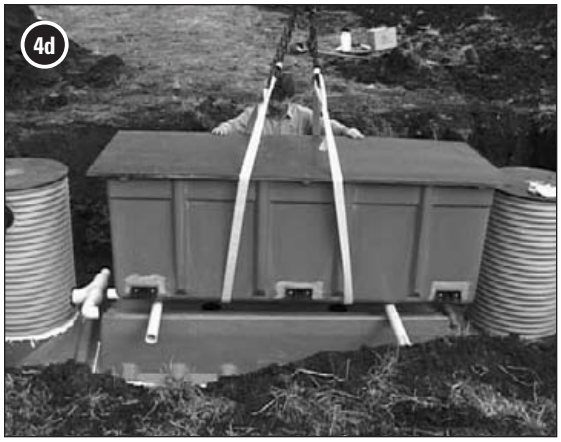
### With a concrete tank:

**Step 4a:** If a concrete tank is used, we recommend placing the AdvanTex pod to the side of the tank. If you wish to install the pod directly over the top of the tank, follow the tank manufacturer's guidelines for backfilling the tank and place a layer of compacted soil or sand between the top of the tank and the bottom of the pod in order to get the required slope on the filtrate return line, as described in Step 2a.

**Step 4b:** Set the AdvanTex pod in place. An AX20 weighs about 300 lb (136 kg) dry. If moving the pod manually is not feasible, you can lift and set the pod into place by slinging two wide truck straps under the entire unit and lifting it with a backhoe.

**Step 4c:** AdvanTex pods come standard with predrilled fiberglass tabs on the bottom corners and a set of antiflotation flanges. The antiflotation flanges help prevent the pod from floating out of the ground under saturated soil conditions. The antiflotation flanges come with stainless steel bolts for attachment to the predrilled fiberglass tabs. With the flanges in position under the pod, mark and drill 17/64-in. (7-mm) diameter holes in the flanges to line up with the predrilled holes in the tabs. Use the 1/4-20 × 1.25 bolts and nuts provided to attach the flanges to the tabs.

***NOTE:*** *Do not try to hoist the pod with straps once the antiflotation flanges are attached! Lower the pod into the hole onto 2 × 4s or similar supports, bolt on the flanges, then remove the 2 × 4s.*



## With the Orenco Fiberglass Tank and Tank Saddle:

If you're using the Orenco Fiberglass Tank and Tank Saddle, the saddle should be attached to the tank already. If you need to attach the saddle to the tank, refer to NIN-SAD-1, *Tank Saddle Installation Instructions.** You will not need antiflotation flanges for the pod.

**Step 4d:** Using a backhoe, lower the pod onto 2 × 4s or sections of pipe and remove the lifting straps.

**Step 4e:** Sand the bottom edges of the pod that will rest on the pre-sanded areas of the saddle, and wipe them with acetone to prepare them for gluing.

**Step 4f:** Apply a bead of methacrylate adhesive to the sanded area of the saddle where the pod will rest, moving the pod on its supports as necessary.

**Step 4g:** Remove the supports one by one and lower the pod onto the saddle, making sure that the pod is completely seated in the saddle.

***IMPORTANT:*** *Attaching the pod to the tank with the saddle adds the pod's buoyancy to the tank's, which in noncohesive soils** makes it necessary to pour a concrete antiflotation collar around the midseam of the tank. Consult a local soils engineer if you are unsure whether a concrete collar is needed. Instructions for pouring the collar are in the* Fiberglass Tank Installation Instructions *(NIN-TNK-1).**

* *These documents are included with the components to which they refer. You can also download them from the Document Library at www.orenco.com*

** *As described in OSHA Standards (29 CFR, Part 1926, Subpart P, Appendix A), noncohesive soils or granular soils include gravel, sand, or silt with little or no clay content. Granular soil cannot be molded when moist and crumbles easily when dry. Cohesive soils include clayey silt, sandy clay, silty clay, clay, and organic clay. Cohesive soil does not crumble, can be excavated with vertical sideslopes, is hard to break up when dry, and when moist, can be rolled into threads without crumbling. For example, if at least a 2-in. (51-mm) length of 1/8-in. (3-mm) thread can be held on one end without tearing, the soil is cohesive.*

## *Step 5: Install Filtrate Return and Discharge Lines*

### If using a concrete tank:

**Step 5a:** Connect the outlet at the bottom of the pod to the reducing coupling on the split-flow tee using nominal 2-in. PVC pipe and fittings as necessary. We recommend using two 45° or 90° elbows to create the necessary minimum 2% slope (or minimum 1-1/2-in. [38-mm] drop) between the pod outlet and the tee.


### If using an Orenco FRP Tank and Tank Saddle:

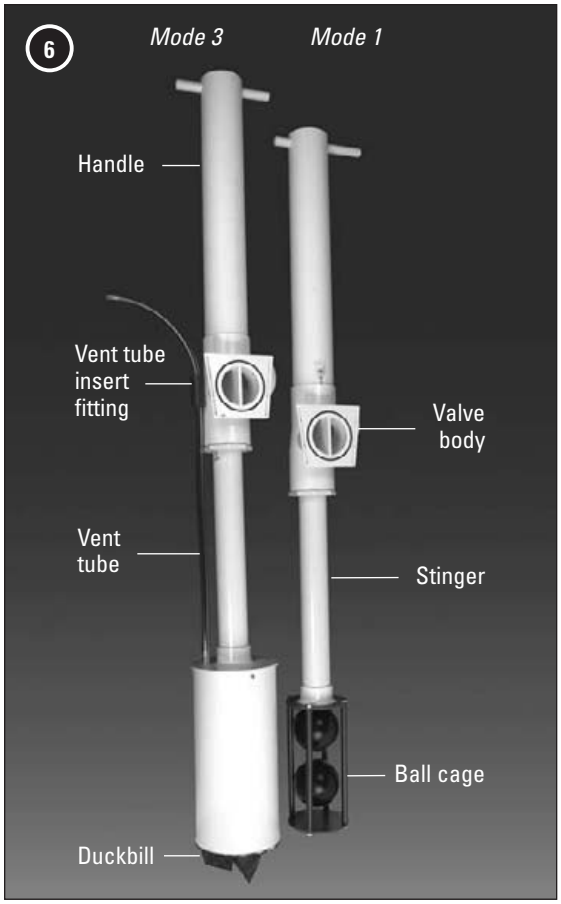
**Step 5b:** Set the pod onto the saddle without adhesive and dry-fit the plumbing. Mark the alignment of the fittings with a waterproof marker.

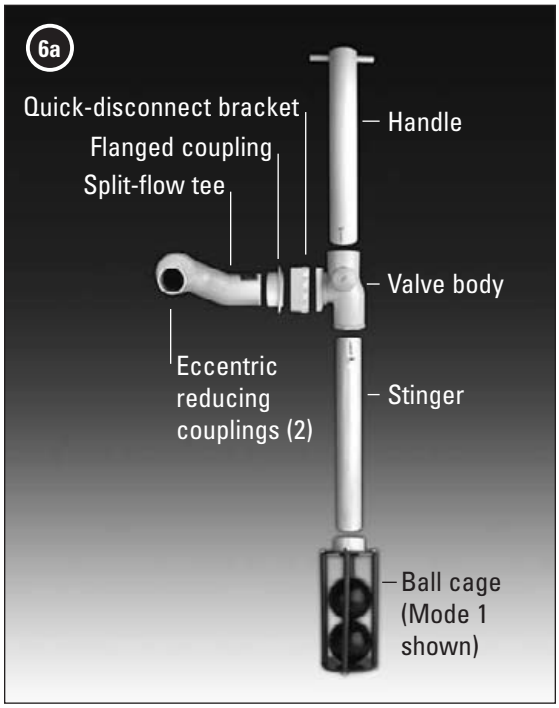

**Step 5c:** Apply methacrylate adhesive to the saddle and set the tank into it as described in Steps 4d to 4g.

**Step 5d:** While the adhesive is wet, glue the fittings together with ABS/PVC transition cement (IPS Weld-On® 794 or equivalent), starting at the split-flow tee, using the marks to align the parts. As the last step, apply cement to the outlet of the pod and the pipe elbow, slide the pod back toward the RSV on the wet adhesive, and connect the fittings.

### For all installations:

**Step 5e:** Connect the 2-in. discharge line from the split-flow tee to the pump basin or to the dispersal area, maintaining a minimum slope of 1/4 in. per foot (2%), as described in Step 2a. Be careful not to create low spots where liquid can pond. Refer to Appendix 4 in this document for more information about installing the pump basin, including watertightness testing.




## *Step 6: Install Recirculating Splitter Valve*

The Recirculating Splitter Valve (RSV) controls the recirculation of effluent returning from the AdvanTex filter pod. Floating balls in the valve rise and fall with the level of liquid in the tank. If the level is high, the valve directs effluent to the dispersal system. If the level is low, effluent returns to the tank for further treatment.

For systems operating in **Mode 1**, the recirculating splitter valve (RSV) is installed in the riser over the tank's second compartment (or in the inlet end of the second tank in a two-tank installation). Whenever possible, the RSV should be installed between the baffle wall and the pump system to ensure mixing of the return effluent.

For systems operating in **Mode 3**, the RSV (duckbill model) is installed in the riser over the tank's inlet. The RSV must be installed so as not to interfere with the inlet tee.

**Step 6a:** Verify that you have all the pieces of the RSV: the handle pipe, body, bracket, split-flow tee, stinger pipe, and RSV cage. The body and cage will be different depending on whether you are installing the Mode 1 or Mode 3 model.

**Step 6b:** If the RSV bracket is <u>not</u> installed, install it now, following the instructions supplied with it (NIN-RSV-3)*.

**Step 6c:** The RSV comes with an 18-in. (457-mm) long stinger pipe. Determine the correct stinger length for your installation and shorten or lengthen the pipe if necessary. If the low liquid level is not specified for the particular installation, refer to Appendix 3 of this manual for typical RSV and float settings. (The normal low liquid level — the level at which 100% of the filtrate returns to the tank — determines the stinger length.)

For almost all applications, the stinger will be shorter than 24 in. (610 mm), and the low liquid level will be approximately 6 in. (152 mm) below the top of the RSV cage. Stingers longer than 24 in. require modified RSV cages. Contact your Dealer or Orenco for more information.

***IMPORTANT:*** *Correct stinger length is critical to the proper operation of the system!*

* *This document is included with the component. You can also download it from the Document Library at www.orenco.com.*

**Step 6d:** After you've cut the stinger pipe to the correct length, attach it to both the RSV cage and the RSV body using PVC cement.

***IMPORTANT:*** *Some RSV3Q parts are ABS and others are PVC. Use all-purpose ABS/PVC transition cement (such as IPS Weld-On® 794) to join them. Do not use primer on ABS parts.*

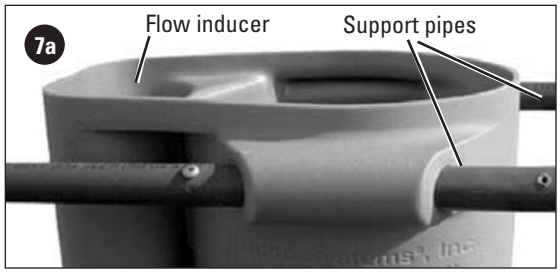
**Step 6e:** Mode 3 installations require the duckbill model RSV, which has a flexible PVC tube that vents the RSV cage to atmosphere. Push the flexible PVC tube onto the insert fitting on the cage. Thread the other end of the tube through the tube holder at the top of the RSV body. Leave about 6 in. (152 mm) of tube extending through the tube holder. Any excess can be cut off.

**Step 6f:** If your riser is less than 30 in. (762 mm) high, shorten the handle as needed by cutting out the excess. Then glue it into the top of the RSV body with ABS/PVC transition cement, such as IPS Weld-On® 794. Orient the handle crosspiece so that it is close to the side of the riser instead of sticking out into the middle.

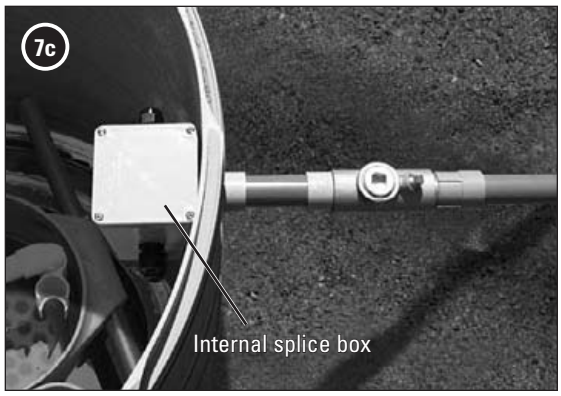
**Step 6g:** Push the RSV body down into its bracket until the valve body is flush or almost flush with the bracket. Use your weight to push it down, and then wiggle it till you're sure it's snug.



*Completed installation shown.*









## *Step 7: Install Biotube® Pump Package*

The Biotube pump vault holds the Biotube effluent filter and a high-head pump. Your vault may have support pipes to allow it to hang from the rim of the tank at the bottom of the riser, or it may be an "earless" vault designed to rest on the bottom of the tank.

**Step 7a:** If your vault includes support pipes, detach them from the packaging material, and remove one of the two screws from each pipe. Slide the support pipes through the holes in the support brackets at the top of the vault. Reinstall the screws.

**Step 7b:** Gently lower the vault into position in the access riser. If there are support pipes, they should rest on top of the tank, and if the vault is earless, it should rest on the tank bottom.

**Step 7c:** A splice box houses the connections for the pump and float switches. Either an internal splice box or an external splice box can be used.

To install an internal splice box into an access riser, lubricate both the outside of the conduit coupling and the grommet with pipe lubricant or an equivalent product and slide the coupling through the grommet until the box is snug against the riser wall. Use a conduit seal to ensure condensation does not affect the system.

The Dealer usually installs the external splice box before delivering the riser, but if yours is not installed, refer to the *External Splice Box Installation Instructions* (EIN-SB-SBEX-1)* supplied with it.

* *This document is included with the component. You can also download it from the Document Library at www.orenco.com.*

**Step 7d:** Screw discharge assembly into pump. Carefully lower the pump and discharge assembly into the flow inducer of the Biotube pump vault.

***IMPORTANT:*** *Do not use the pump cable to lower the pump!*

**Step 7e:** Using pipe lubricant or an equivalent product, lubricate the access riser grommet and the gray nipple on the discharge assembly. Push the nipple through the grommet and orient the discharge assembly to make component removal for maintenance easy.

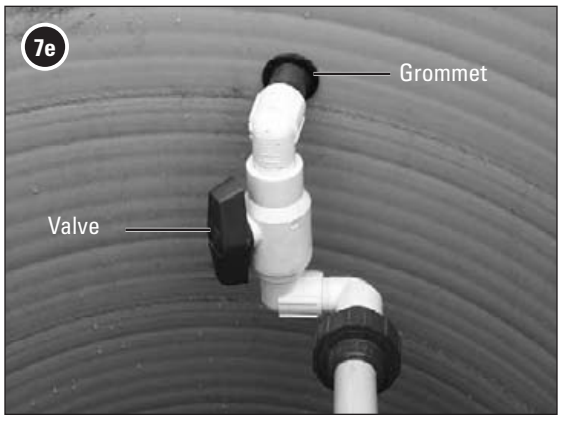
**Step 7f:** Clip the float switch assembly into the float bracket on the Biotube filter handle. Make sure you can detach it without removing the Biotube cartridge or pump vault.

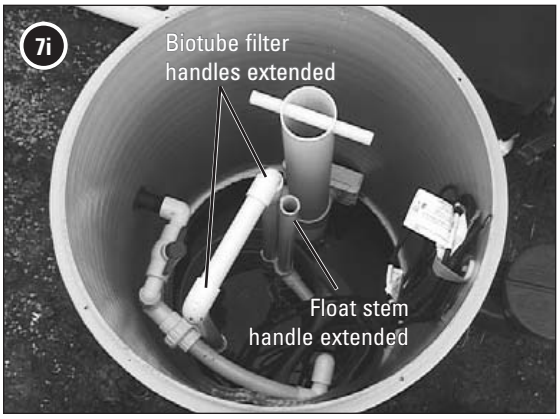
**Step 7g:** Although float switches are set at the factory for the appropriate depths, compare the float settings with the project plans and specifications to make sure the settings are correct. If you need to adjust a setting, refer to Appendix 3 at the end of this document for typical RSV and float settings for residential systems.

**Step 7h:** If you have an "earless" vault with a lifting rope, coil the rope neatly and secure it to the splice box along with the float cords so that it does not fall into the vault or interfere with the floats.

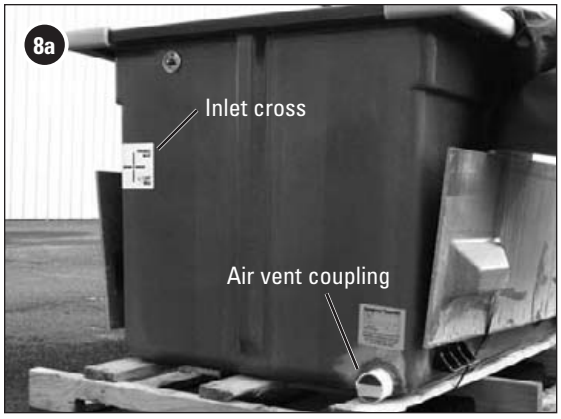
**Step 7i:** Make sure that the components are arranged in the riser so that you can pull out the Biotube filter cartridge and the float stem without having to disconnect anything. Extending the Biotube cartridge's handles with one-inch pipe and extending the float stem in the same way will make maintenance easier.

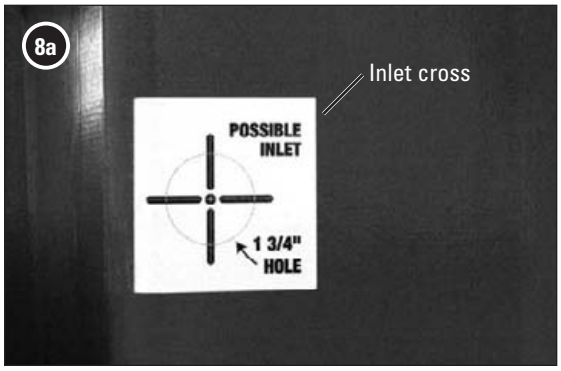
***NOTE:*** *Refer to* ProSTEP Effluent Pump Packages Installation Guide (NIM-EPS-1) *for more detailed pump package installation instructions.**

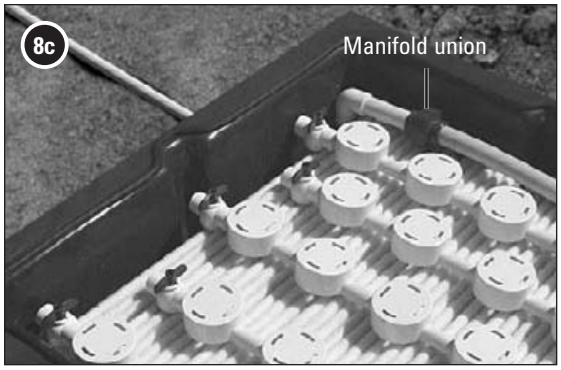




* *This document is included with the component. You can also download it from the Document Library at www.orenco.com.*




## *Step 8: Connect Transport Line to Pod*

The transport line conveys effluent from the discharge assembly to the pod. The transport line can be connected to either end of the AdvanTex pod. Installing it in the end opposite the discharge line — on the same side as the passive air vent — will facilitate cleaning.

**Step 8a:** Determine which end of the pod you are installing the transport line into, and cut a 1-3/4-in. hole in the pod where it is marked with a cross. (If you are using piping other than U.S. nominal 1-in., measure your grommet and cut the hole to fit.) Remove any burrs and install the 1-1/4-in. grommet, sealing it in place with ADH100 adhesive.

**Step 8b:** From the inside of the pod, insert the lower manifold elbow through the grommeted hole, and connect the 1-in. transport line from the discharge assembly to this elbow. In cold weather installations, slope the line so that it drains back to the tank after every cycle. We recommend installing a coupling on the transport line outside the pod next to the grommet to prevent the line from being pushed into the pod during installation or maintenance.

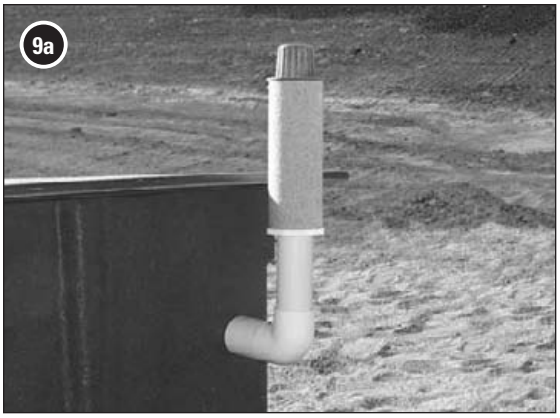
**Step 8c:** Temporarily disassemble the manifold union so that, when the pump first comes on during start-up, any debris in the transport piping will not be pumped into the manifold (which could then require orifice cleaning).

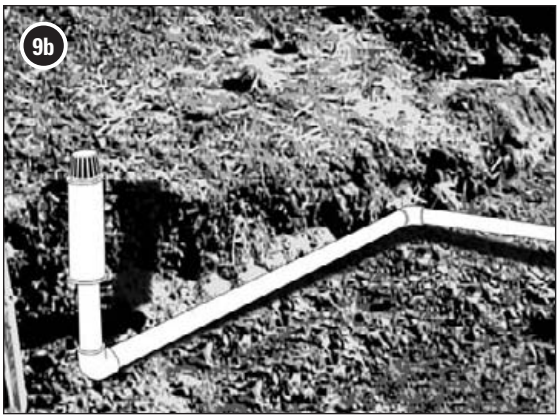
## *Step 9: Install Passive Air Vent*

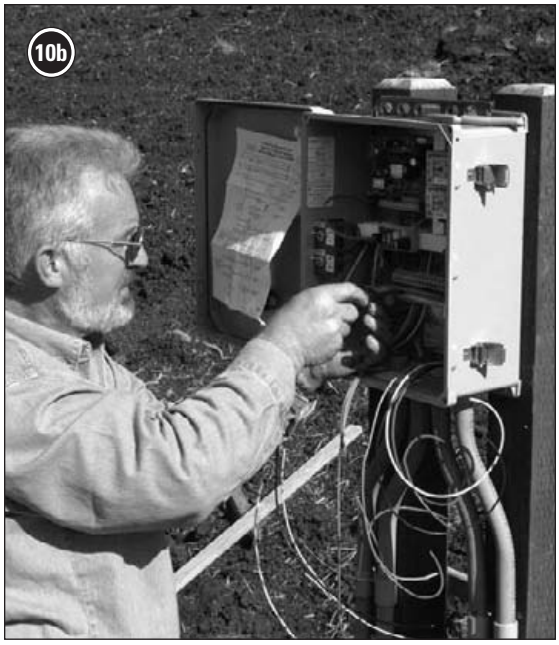
**Step 9a:** Using 2-in. PVC pipe, plumb the passive air vent to the 2-in. fitting that protrudes through the filter wall. Be sure the vent line is sloped to drain into the textile filter, to prevent accumulation of water in the vent line.

**Step 9b:** You might want to install the air vent near a wall or in a similar location where it is less likely to be damaged by a lawn mower or accidental kicking, etc. You can easily hide the air vent behind shrubbery or other landscaping and paint it if another color is desired.

***IMPORTANT:*** *In all cases, the line between the air vent and the filter must be sloped back toward the filter. To prevent accumulation of water, do not allow any "bellies" or low points in the vent piping. Keep the 2-in. vent piping less than 20 ft (6 m) in total length.*






## *Step 10: Install Control Panel*

For complete control panel installation instructions, see the installation manual for the electrical control panel that comes with your system. These instructions ship with the control panel and hang from a clip on the inside of the panel door.*

**Step 10a:** Make sure the instructions and the items supplied conform to state and local regulations.

**Step 10b:** A qualified and licensed electrician should install and service the panel and ancillary wiring in compliance with the National Electrical Code, as well as state and local codes. (Wiring diagrams can be found in the installation manual* that comes with the panel.) Wiring will include the following items:

*a) Incoming power to the panel. One or more circuits may be required, depending upon the number of pumps and local electrical codes.*
*b) Incoming phone line to the panel (for VeriComm).*
*c) Wiring from the control panel to the pump and floats.*
*d) Wiring to a discharge pump and floats (if applicable).*

***NOTE:*** *We do not recommend installing a control panel against the wall of a bedroom, living room, or other living space because it makes a periodic thump during operation. If it must be placed near the house, mount it on 4 × 4 (100 × 100 mm) posts next to the wall.*

* *If the instructions are missing or have been removed from the door pouch inside the control panel, call Orenco for a replacement or download a copy of the instructions from our online Document Library at www.orenco.com.*

## *Step 11: VeriComm® Control Panel Functional Test*

VeriComm® (VCOM) telemetry-enabled panels are used for remote monitoring and control of AdvanTex pumping operations.

Fault conditions are automatically reported to the VeriComm Monitoring System, making the system virtually invisible to the homeowner. However, if fault conditions are not responded to, or if the system cannot communicate with the VeriComm Monitoring System, then local alarms may be activated.

Follow the procedures below to verify proper installation of the VeriComm panel.

***NOTE:*** *For more detailed procedures specific to each panel model, refer to the documentation that comes with the panel.**

**Step 11a:** Familiarize yourself with the components of the telemetry control board.

**Step 11b:** Make sure the panel has been completely and correctly installed, and verify that the circuit breakers are in the "On" position. Also check the controller status. The "Power LED" located on the control board will be:

- *Blinking, which indicates the controller is operating normally, or*
- *Off (when power is applied), which indicates a possible problem with*
  - *~ the input fuse on the PC board;*
  - *~ the main fuse located inside the panel;*
  - *~ the controls circuit breaker located inside the panel; or*
  - *~ the incoming line voltage.*

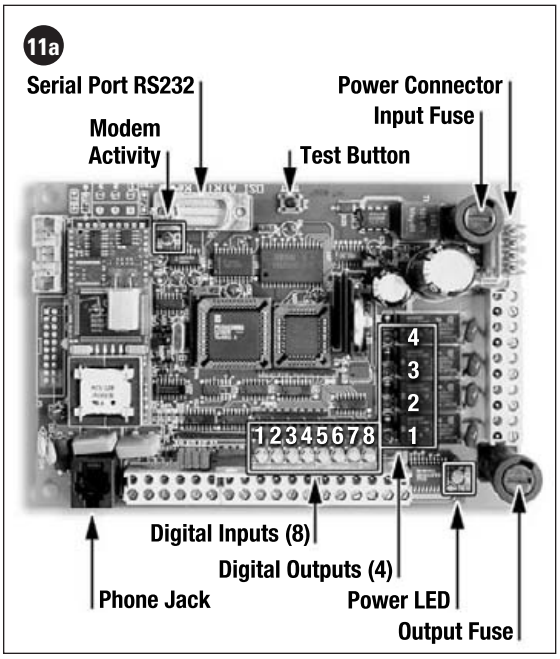
**Step 11c:** To enable Test Mode, hold the "Push-To-Silence" button on the front of the panel until the audible alarm sounds (approximately 15 seconds).

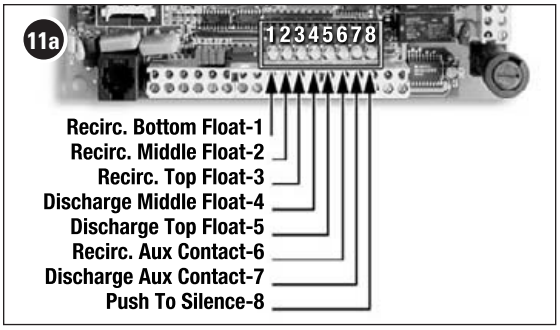
- *The appropriate digital input should be illuminated when the button is held in.*
- *When the audible alarm sounds to indicate that the panel is in Test Mode, release the button.*

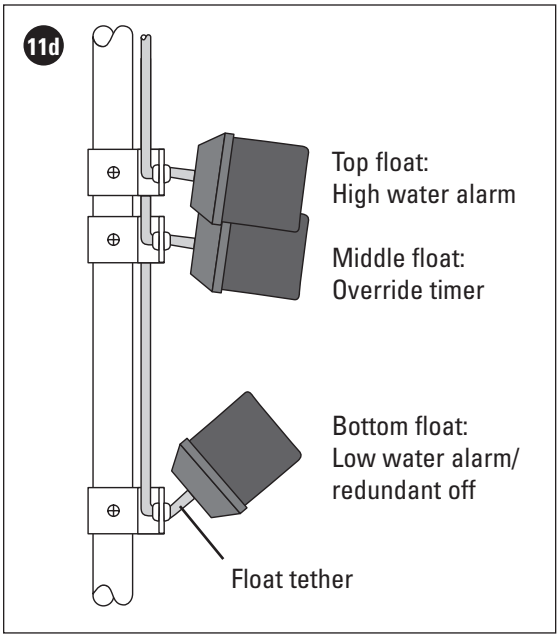
While in Test Mode, the panel will operate in the following manner:

- *The call-in function is disabled;*
- *Local audible and visual alarms are activated as alarm conditions occur;*
- *System Data Logs are suspended; and*
- *Timer cycles are shortened.*

**Step 11d:** Familiarize yourself with the floats on the system.

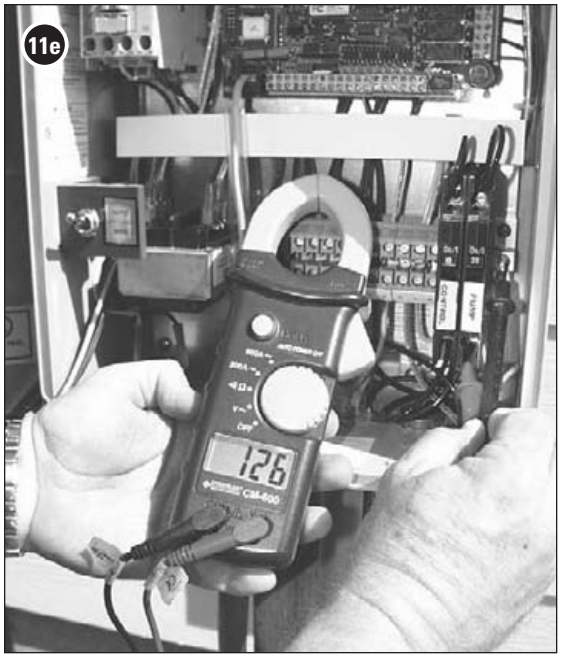



*VeriComm® Recirculating Float Assembly shown*

* *If the instructions are missing or have been removed from the door pouch inside the control panel, call Orenco for a replacement or download a copy of the instructions from our online Document Library at www.orenco.com.*




*Measure voltage*


*Measure amperage*

**Step 12e:** Verify that the pump is submerged in water before continuing. If the bottom float drops, the alarm should sound. Press down the spring-loaded "MAN/AUTO" switch located inside the panel. The pump should immediately activate. For verification, the appropriate digital input should illuminate, indicating that the auxiliary contact is on.

Measure the voltage and amperage of the pump.

a) *Measure the voltage at the pump terminals in the panel. Measuring the voltage with the pump off will confirm that the correct voltage is connected. Then activate the pump by flipping the MAN/AUTO switch to MAN, or using a PDA or laptop with the Bluetooth Device, and measure the voltage while the pump is running. A low voltage condition could indicate that the site wiring is improperly sized.*

b) *Using a loop ammeter, place the ammeter clamp around the loop of wire located above the pump circuit breaker and read the amperage while the pump is running and connected to the discharge assembly with the valves at the end of the laterals closed. The amperage should be within the specifications of the pump.*

**Step 12f:** Refer to the control panel documentation to test the floats that activate/deactivate the pump. To perform the float test, make sure there is a sufficient amount of liquid in the tank. If there is not enough liquid in the tank, turn the pump circuit breaker off.

**Step 12g:** Press and release the "Push-To-Silence" button 15 times within a one-minute period. This instructs the panel to call the VeriComm Monitoring System.

- *A red LED ("Modem Activity" component) should illuminate, indicating that the controller has established communication with the host. (This may take a few minutes.)*
- *Once the communication session has ended, the modem will automatically disconnect.*
- *If the LED does not illuminate within the specified time, verify that the phone line has a dial tone. This can be done by hooking up a phone to the line that is going into the panel.*

**Step 12h:** The panel will automatically disable Test Mode and return to normal operation after 30 minutes. To disable Test Mode manually, hold the "Push-To-Silence" button on the front of the panel until the audible alarm sounds (approximately 15 seconds). The appropriate digital input should be illuminated when the "Push-To-Silence" button is held in. When the audible alarm sounds to indicate that the panel is no longer in Test Mode, release the button.

## *Step 12: System Functional Test*

Once power is connected to the control panel, follow these steps to prepare the system for operation.

**Step 12a:** For Mode 1B and 3B installations, fill the pump basin with water to a level just below the lowest float.

**Step 12b:** Verify both manual and automatic operation of the recirculation pump. Before running the pump, ensure that the tank's water level is at least 4 in. (102 mm) above the bottom float, but below the top float. *Be sure that you have temporarily disconnected the manifold union.* Hold the toggle switch in the control panel on "Manual" to test manual operation of the pump and clear any debris in the transport piping.

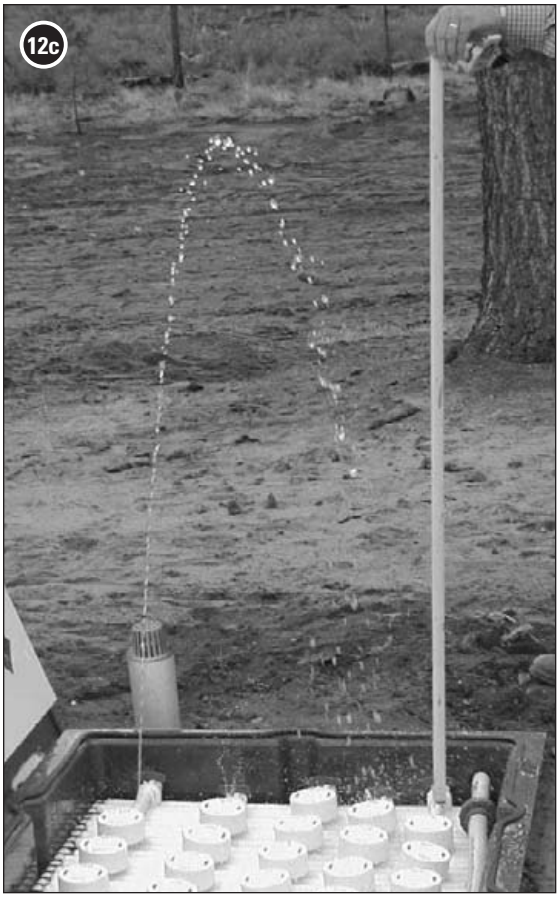
**Step 12c:** Reconnect and hand-tighten the manifold union. Verify that all the lateral ball valves are open, and run the pump in the "Manual" position for 5 or 10 seconds to flush any construction debris out of the manifold piping. Completely close all lateral valves after flushing is complete. With the pump still running manually, remove several orifice shields and measure the squirt height with a tape measure. The squirt height should measure approximately 3-5 ft (0.9-1.5 m). Windy conditions will cause the squirt heights to measure less.

***NOTE:*** *If the desired squirt height is not achieved or the system does not pressurize, check for debris, breaks, or closed valves. Also verify that the pump is receiving sufficient power. If the system still does not pressurize correctly, contact your Dealer or Orenco for technical assistance.*

**Step 12d:** For more accurate residual head measurements, attach a piece of clear PVC to the end of the lateral. Record the residual head measurement at start-up and before and after servicing.

**Step 12e:** Return the MAN/AUTO switch to "Automatic." To facilitate quick testing of the automatic operation, put the panel into Test Mode.

**Step 12f:** Fill the tank with clean water up to a level approximately 1 in. (25 mm) above the RSV cage. At this point the water level should be well above the bottom float. In the control panel, turn on the pump by holding the toggle switch in the "Manual" position. As water begins running through the system, ensure proper drainage through the filtrate return line and RSV. All or some of the return filtrate flowing to the RSV should be exiting the system through the final discharge line. Check that no water is leaking at any of the plumbing joints.





***IMPORTANT:*** *Before using a generator to operate a pump, contact Orenco or your Dealer to make sure it can supply sufficient starting amperage.*


## *Step 13: Backfill Installation*

***NOTE:*** *Before backfilling, make sure all pod and riser lids are bolted down.*

**Step 13a:** Backfill the excavation. Follow the tank manufacturer's guidelines for backfilling the tank.

**Step 13b:** Backfill and compact around the AdvanTex pod in maximum 12-in. (305-mm) lifts. Native material is acceptable if there are no large or sharp rocks that may damage the filter walls. If native material is not usable, backfill with sand or pea gravel. Slope the ground away from the pod to prevent surface water from ponding on or around the pod.

***IMPORTANT:*** *When backfilling, be careful not to alter the slope of pipes. Brace the pipes and carefully fill around them.*

**Step 13c:** Make sure all lids are secured before leaving.

***IMPORTANT:*** *After backfilling, call the system's Service Provider to arrange for the official System Start-up.*

# Appendix 1: *AX20 Timer Settings Worksheet*

The following chart shows recommended timer settings for a new system.

| RESIDENTS | TIME ON (SEC) | TIME OFF (MIN) | NOTES |
|---|---|---|---|
| 2 | 10 sec (.17 min) | 20.00 | • Assumes water usage of 50 gal. (190 L) per person per day and a return recirculation ratio of 3 : 1 (Filter recirculation ratio of 4 : 1). • Override OFF cycle time is set at one-half of the OFF cycle time. Override ON cycle time is set the same as the ON cycle time. |
| 3 | 15 sec (.25 min) | 19.75 | |
| 4 | 20 sec (.33 min) | 19.45 | |
| 5 | 25 sec (.42 min) | 19.70 | |
| 6 | 30 sec (.50 min) | 19.50 | |

As you gain experience with a system, you may conclude that you need to make adjustments, sometimes significant ones. This worksheet is intended to help you determine appropriate start-up timer settings (Pump ON, pump OFF) for a single-pod AX20 system. Typical values and ranges are provided for each parameter. If you have any questions or if your values fall outside the desired ranges on this worksheet, contact your Dealer.

| PARAMETER | | TYPICAL VALUES | NOTES |
|---|---|---|---|
| | Number of people | 3 | Range of 2 to 8 people. |
| | Water usage per person | 50 gpd (190 L/d) | Typical daily average is 50 gal. (190 L) per person. |
| $Q_i$ | Actual daily flow (total) | 150 gpd (570 L/d) | (Number of people) x (water usage per person). |
| $R_b$<br>$R_f$ | Return recirculation ratio<br>Filter recirculation ratio | 3 : 1<br>4 : 1 | You can adjust this ratio (return flow to forward flow) up or down depending on system performance. (Range of 2 to 6.) |
| | Total daily flow to AX20 | 600 gpd (2280 L/d) | (Actual daily flow) x (return recirculation ratio + 1). Must be ≤ 3000 gpd (11,370 L/d). Actual flow should not exceed 500 gpd (1895 L/d). (500 gpd x 6:1 $R_b$ = 3000 gpd) |
| $Q_d$ | Actual pump dose rate | 33.3 gpm (126 L/min) | Determine this value by field-testing or by using Orenco's *PumpSelect™*. Start at the low end. |
| $T_d$ | Pump ON cycle time (dose) | 0.25 min | Select a value between 0.17 minutes (10 seconds) and 0.75 minutes (45 seconds). |
| $T_r$ | Pump OFF cycle time (rest) | 19.75 min | See Pump OFF equation below. |

| PUMP OFF EQUATION | EXAMPLE |
|---|---|

Plugging in the above values and rounding, we get the following:

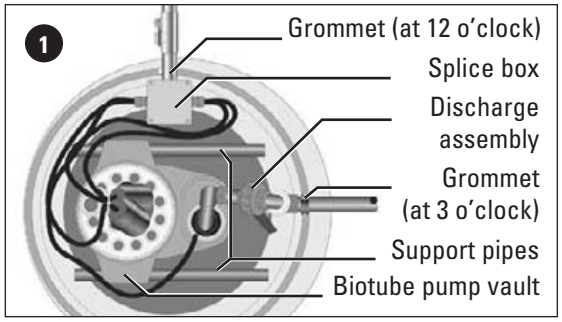
$$T_r = \left[\frac{1440 * T_d * Q_d}{(R_b + 1) * Q_i}\right] - T_d$$

$$T_r = \left[\frac{1440 * 0.25 * 33.3}{(3 + 1) * 150}\right] - 0.25 = 19.74 \approx 19.75$$

After you determine your Pump ON and Pump OFF times, double check to make sure your start-up settings fall within the cycle time (CT) range, below. If they don't, make adjustments per the "Note."

| ADDITIONAL PARAMETERS | | TYPICAL VALUES | NOTES |
|---|---|---|---|
| CT | Cycle time | 20 min | Low flow applications may result in cycle times of an hour or more, which can cause the media to dry out or odors to develop in the recirc tank. If CT is much more than 30 minutes, consult your Dealer or Orenco for suggested adjustments. |
| | Pump cycles per day | 72 cycles | 1440 min/day ÷ (OFF cycle time + ON cycle time). Must not exceed the pump's maximum rated cycles per day of 300 cycles per day. |
| | Gallons per cycle | 8.3 gal. (31 L) | With 68 orifices and using the Td range recommended above, you will maintain the recommended 0.08 to 0.25 gal. (0.45 to 0.95 L) per orifice per dose. |

# Appendix 2: *Installing Grommets*








**Step 1:** To install grommets in the field, first mark the riser for location of the grommets. (For Perma-Loc risers, you should try to avoid cutting through the pipe seam — the extra thick rib — unless it is unavoidable.)

**Step 2:** Using a 4-in. (100-mm) grinder or other cutting tool, notch through the PVC ribs to the wall of the PVC riser. Remove an area of ribbing equal to approximately 1 in. (25 mm) larger than the grommet diameter.

**Step 3:** Using a hammer and chisel, break the notched ribs from the riser. Use a grinder to remove any remaining rib material so that you are left with a smooth area, ensuring a watertight fit. (Hole saws with attached pocket cutters are available from Orenco; they cut away the ribs as the hole is cut, eliminating the need to notch and break the ribs.)

**Step 4:** Using the Grommet Hole Saw Sizing Chart below, select a hole saw for the grommet installation and drill out the opening. (If you are using pipe and grommets other than U.S. nominal sizes, ascertain the correct hole size for your grommet.) Use a deburring tool or knife to deburr the edges of the opening, being careful not to enlarge the opening.

## *Grommet Hole Saw Sizing Chart*

| Grommet Size (in.) | Hole Size (in.) |
|---|---|
| 1/2 | 1 |
| 3/4 | 1-1/4 |
| 1 | 1-9/16 |
| 1-1/4 | 1-3/4 |
| 1-1/2 | 2-1/8 |
| 2 | 2-3/4 |
| 3 | 3-7/8 |
| 4 | 5 |

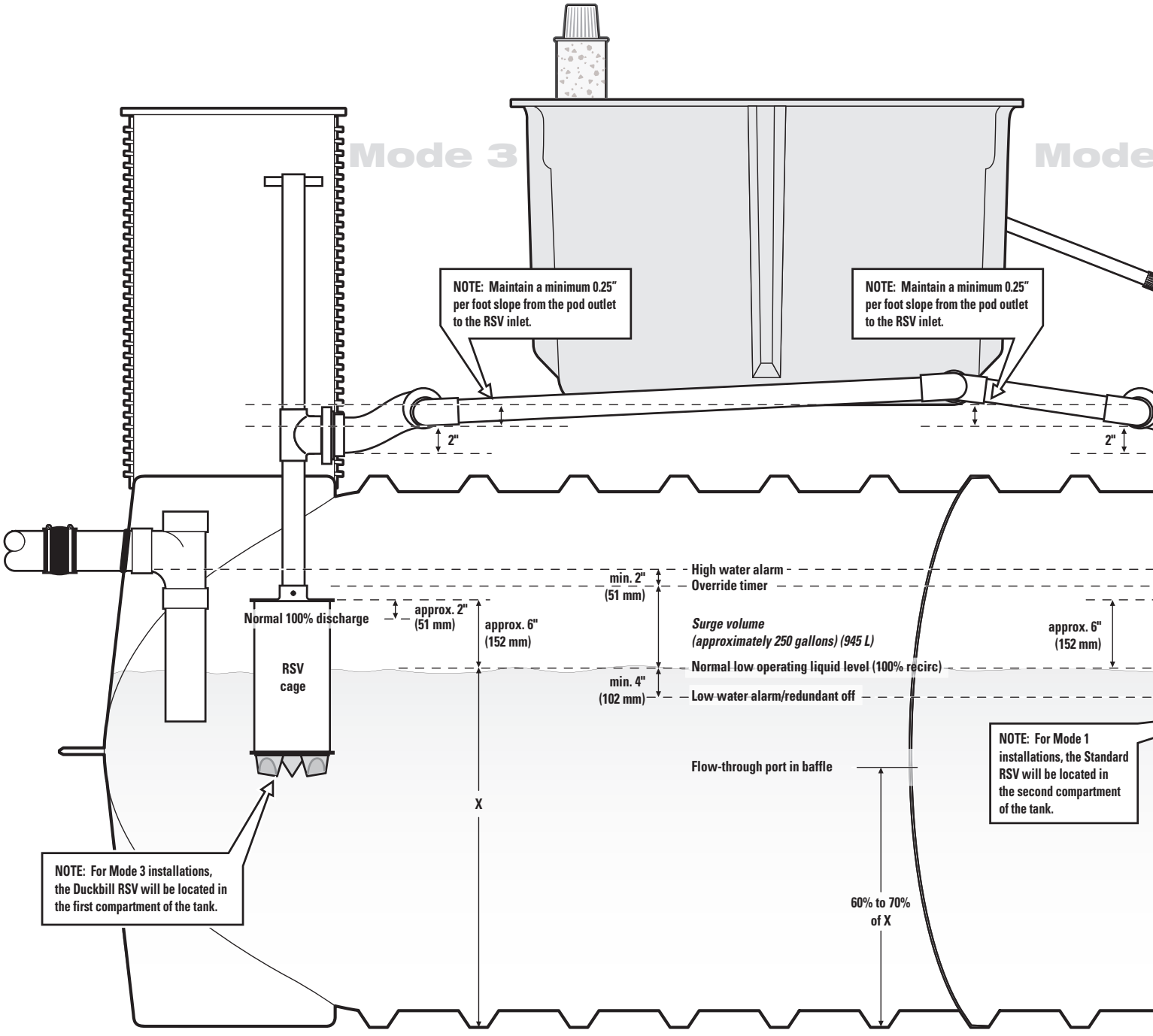
***NOTE:***
*Grommet size = nominal (IPS) pipe size. For more information about grommet dimensions and actual pipe O.D., see Orenco's Grommet Submittal (NSU-RLA-PG-1), available from the Document Library at www.orenco.com.*

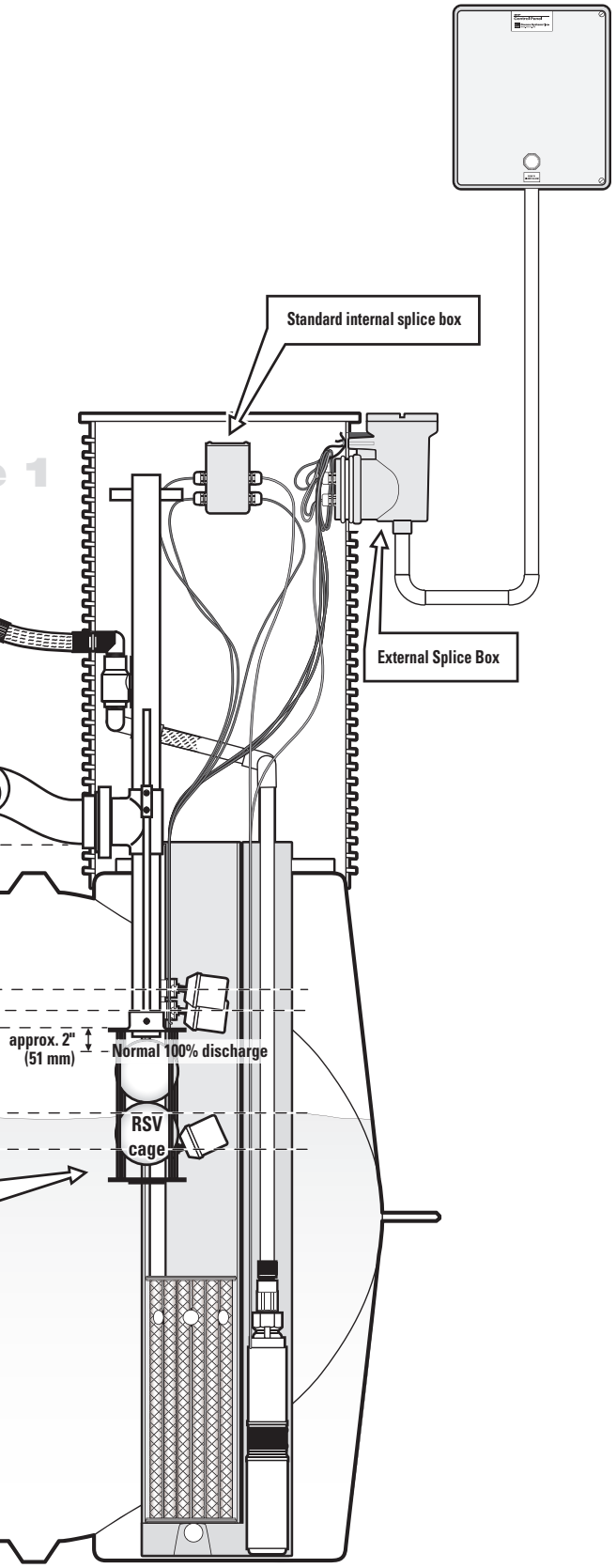
**Step 5:** Install the grommet in the riser. Apply a bead of ADH100 adhesive to the groove of the grommet prior to insertion into the riser hole. This will make the grommet more secure and will overcome any imperfections in the drilled hole.

# Appendix 3: *RSV and Float Level Diagram*

This diagram shows RSV and float levels for a system that uses a VeriComm Control Panel. With an MVP Control Panel, a two-float configuration is used (the high water and override floats are combined), and therefore this top combination float may be located 1-2 in. (25-51 mm) below the invert of the inlet.

**This diagram shows both a Mode 1 and a Mode 3 setup.** For Mode 1 setups, the recirculating splitter valve (RSV) is installed in the second compartment, with the Biotube pump vault. For Mode 3 setups, the RSV is installed in the first compartment, under the inlet riser.






## Determine the RSV Level

For stinger pipe lengths up to 24 in. (610 mm) long, the "normal low operating liquid level" will be approximately 5-6 in. (127-152 mm) below the top of the RSV cage. (The normal low operating liquid level is the level at which 100% of the filtrate returns to the tank.) For most residential applications, the recommended surge volume — the volume between the low liquid level and the high water alarm float — is approximately 250 gallons (948 L). For Mode 3 installations, the duckbill model RSV, which has a flexible PVC tube that vents the RSV cage to atmosphere, is required.

## Determine the Float Levels

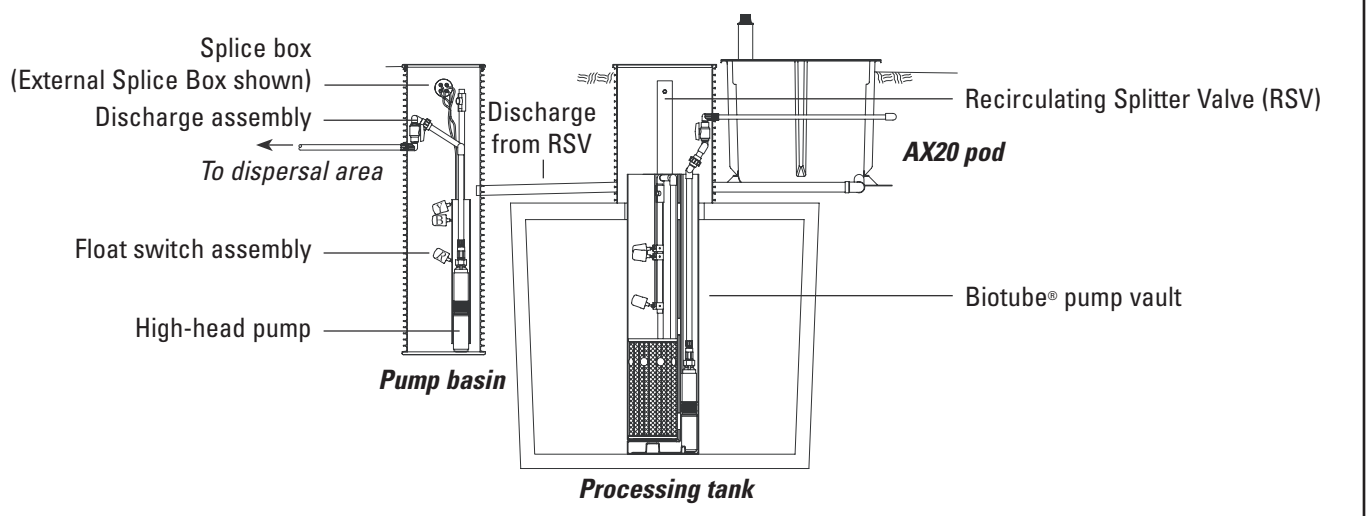
Be sure to check the plans for any site-specific or tank-specific float settings. The top float is normally set equal with the tank's invert of inlet. The bottom float should be approximately 4 in. below the normal low operating level.

***NOTE:*** *Before leaving the site, verify that the "low water alarm/ redundant off" float is positioned at least 10 in. (254 mm) below the top of the RSV cage.*

# Appendix 4: *PBAX Pump Basin Installation*

In AdvanTex® Treatment Systems, the Recirculating Splitter Valve (RSV) discharges treated effluent via gravity. If the dispersal area requires the use of a pump, the RSV discharges to a PBAX Pump Basin. From there, a high-head pump delivers it in doses to the drainfield.

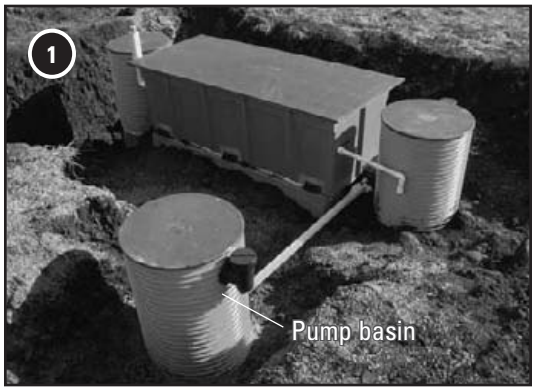
Typically, the PBAX consists of a 24-in. pump basin equipped with a high-head pump, a float switch assembly, a splice box, a discharge assembly, and a lid.




## Step 1: Plan the Installation

The PBAX Pump Basin is typically installed near the AdvanTex system. For ease of installation, the excavation for the pump basin can be connected to the excavation for the tank as shown in the illustration, so that the bottom of the pump basin's hole is accessible.

*NOTE: If groundwater will rise above the bottom of the pump basin at any time, you will need to set the pump basin in concrete to counteract its buoyancy.*




## Step 2: Install the Splice Box (if necessary)

The dealer typically installs the External Splice Box before delivering the riser. If it is not installed, or if an internal splice box is used, install it now following the directions supplied with the splice box.


*External splice box*

*Internal splice box*



## Step 3: Set the Pump Basin in the Hole

Dig the hole for the pump basin four inches deeper than the height of the basin, and place a four-inch bed of compacted gravel in the bottom of the hole. Place the pump basin in the hole. Orient it so as to minimize the number of bends in the electrical conduit between the control panel and the splice box. Partially backfill the hole to support the basin while you're working on it.

If you are going to set the pump basin in concrete, set the basin on its gravel bed, mix a three-bag batch of concrete, and pour it around the bottom of the basin. The concrete should extend six inches on all sides of the basin.

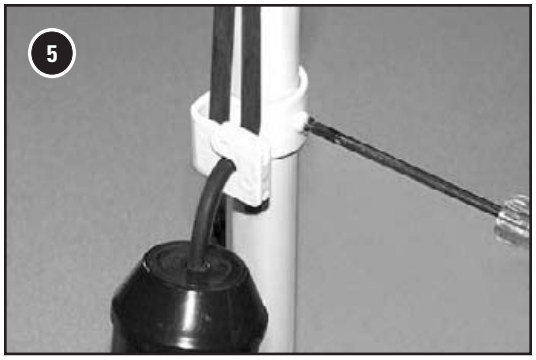
## Step 4: Install the Filtrate Line

**Step 4a:** To mark the position of the inlet hole on the pump basin, extend a piece of pipe or a straightedge from the outlet of the RSV to the pump basin so that it slopes at least 1/4 in. per foot (2%). Mark the center of the inlet hole on the pump basin, and install a 2-in. grommet. Apply a bead of ADH 100 adhesive to the 2-in. grommet and install it in the hole. Lubricate the inside of the grommet with pipe lube.

**Step 4b:** Push the end of the 2-in. filtrate line through its grommet. It must extend far enough into the pump basin to allow attachment of an elbow, but not so far that it interferes with other components. Glue a downward-facing elbow to the end of the filtrate line inside the pump basin. Glue the other end of the line into the discharge coupling of the RSV tee.

**Step 4c:** Drill the appropriately sized hole for the line going to the dispersal area, and install a grommet.

## *Step 5: Set the Floats and Install the Float Assembly*




**Step 5a:** To adjust the height of the float switches, loosen the screw on the float collar and slide the collar along the float tree. Do not try to change the tether length.

**Step 5b:** Set the high level float even with the invert of the inlet pipe. Set the "Pump On" float two inches below that. Set the "Pump Off" float at a level that will produce the desired dose volume for the drainfield. A 24-in. pump basin holds 1.88 gallons per inch of height (2.8 liters per centimeter). Make sure that the "Pump Off" float is not below the pump's minimum liquid level. Make sure that the floats do not interfere with other components in the basin.

**Step 5c:** Install the float assembly in the bracket inside the basin. Wrap the cords neatly and secure them to the splice box using the hook-and-loop strip provided.

## *Step 6: Install the Pump and Discharge Assembly*


**Step 6a:** Assemble the pump and discharge assembly using Teflon paste or tape. Lower the pump into the flow inducer at the bottom of the basin. Insert the nipple of the discharge assembly through the grommeted hole for the line to the dispersal field.

*NOTE: Instructions for installing conduit and wiring in the External Splice Box can be found in the* External Splice Box Installation Instructions *(EIN-SBEX-1)* supplied with the splice box.*

**Step 6b:** Lay the pipe for the line to the dispersal area in the trench and connect it to the discharge nipple using external flex hose. Do not bend the flex hose more than fifteen degrees. If local regulations require it, install toning wire on this pipe before backfilling.

**Step 6c:** Make sure the pump basin's lid is securely screwed on before you leave the site.

* *These documents are included with the component. You can also download them from the Document Library at www.orenco.com.*

## *Notes*

# AdvanTex®-AX Treatment Systems

# Installation Guide

## *Residential Applications*

*AdvanTex® Treatment System AXN models meet the requirements of NSF-ANSI Standard 40 for Class I Systems.*

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**800-348-9843**
**www.orenco.com**
**www.vericomm.net**

**NIM-ATX-AX-1**
**Rev. 3.4, © 2/07**
**Orenco Systems®, Inc.**

O&M

OPERATION & MAINTENANCE MANUAL

# AdvanTex® Treatment Systems

*For Service Providers of*

*Residential AdvanTex® Treatment Systems*

*and for Homeowner Reference*


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## Your Expertise Matters

As the operator and service provider of an onsite wastewater treatment system, you play a crucial role. Property owners, neighbors, regulators, dealers, manufacturers ... all rely on your efficient and effective work.

All onsite systems require servicing, from the simplest of standard stone-trench systems to the most complex tertiary treatment systems. Regular servicing optimizes the treatment process and ensures that onsite systems are a sustainable technology.

To make servicing easier, Orenco has configured the AdvanTex® Treatment System and its components to be one of the most trouble-free and service-friendly residential treatment systems on the market. We've also provided this O&M Manual. In it, you'll find valuable information about . . .

- The AdvanTex System's configuration and treatment process
- Performance expectations (norms) at each stage in the treatment process
- System components
- Routine cleaning and maintenance procedures and frequencies
- Routine cleaning and maintenance checklist
- Testing procedures
- Troubleshooting tips
- Sample documentation
- Equipment and tools checklist

Operation and maintenance of an onsite treatment system requires an understanding of all the above information. So please read through this entire manual first, before providing any service. Then write in the Record of System Facts, on the back page. Reading the manual first and maintaining up-to-date records will save everyone time and money in the long run.

Also, at start-up and periodically thereafter, we recommend that you get together with the system user to review the *Homeowner's Manual* that comes with the system, especially the "Do's and Don'ts." This will educate the user on preventive maintenance and on the operating and maintenance responsibilities of system users and authorized personnel, as well as service-related obligations of the manufacturer. Meeting periodically with the user will also allow you to track any significant changes in the household (e.g., number of occupants, changes in water use, use of detergents, disposal of cleaning compounds, etc.).

We're very proud of the AdvanTex Treatment System. Like all our products, it has gone through extensive research, development, and field-testing. Then each component is built to written specifications and subjected to quality review, before shipping. In addition, our AXN models meet the requirements of ANSI-NSF Standard 40 for Class I Systems. If any component of this System does not meet your expectations, please call your authorized AdvanTex Dealer.

**AIM-OM-ATX**
**Rev. 3.4, © 2/07**
**Orenco Systems® Inc.**

# AdvanTex® Treatment Systems

## Table of Contents





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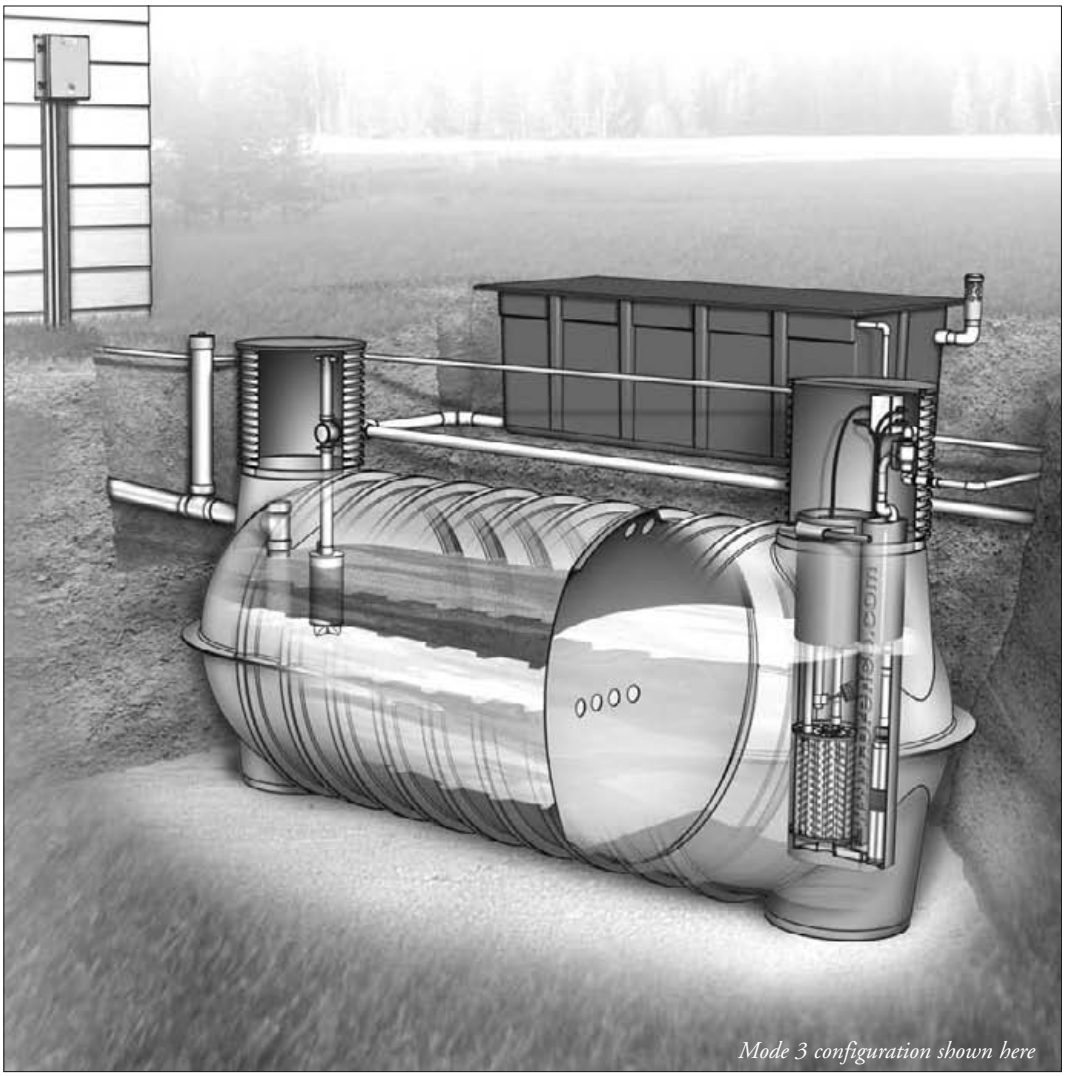
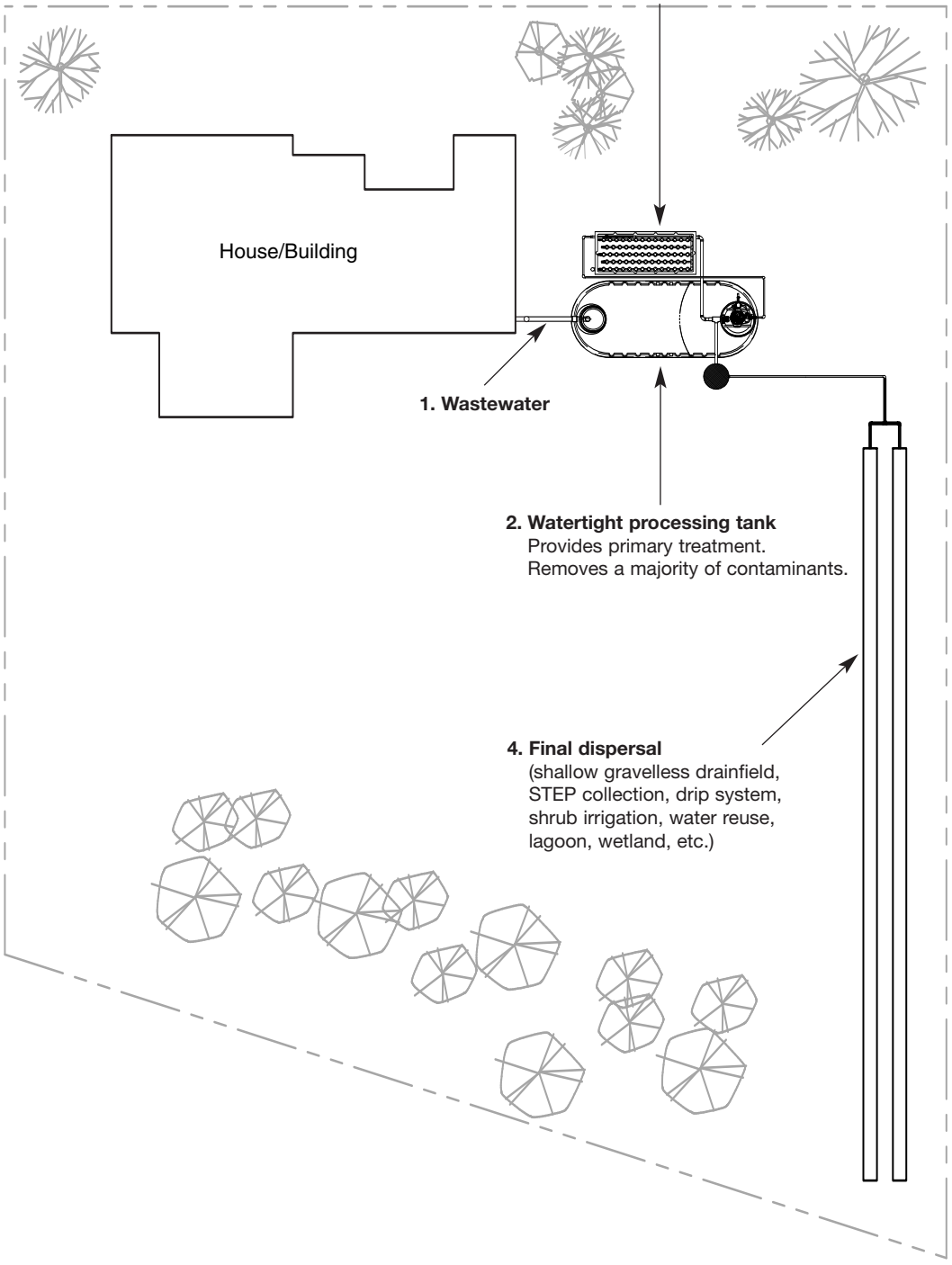
# Typical System Configuration

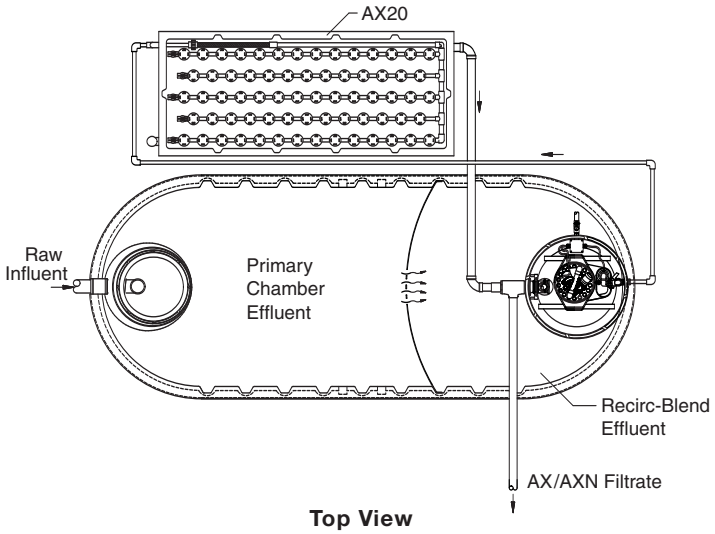



*This 3D illustration shows a typical backyard configuration for the key elements of an AdvanTex® Treatment System, using an AX20 textile filter, which can be neatly positioned on top of or adjacent to the processing tank.*

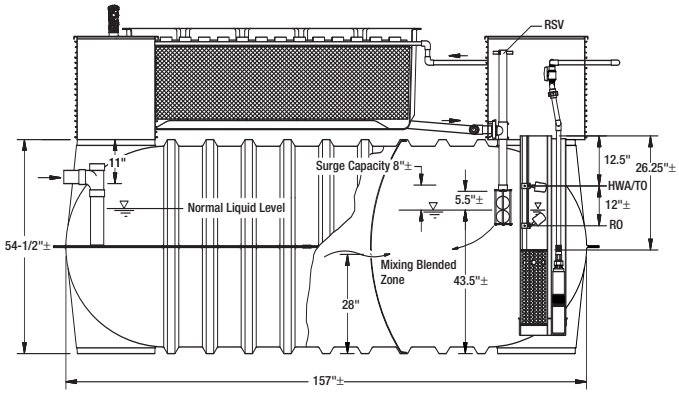
# Typical System Configuration: Plan View



# Treatment Process/Performance Expectations




**Top View**




**Side View**

## Processing Tank

The processing tank provides primary wastewater treatment. The tank is an enclosed, watertight receptacle designed to collect wastewater; segregate settleable and floatable solids (sludge and scum); accumulate, consolidate, and store solids; digest organic matter; and discharge treated effluent. BOD (biochemical oxygen demand) removals of greater than 65% and TSS (total suspended solids) removals of greater than 70% are easily accomplished.

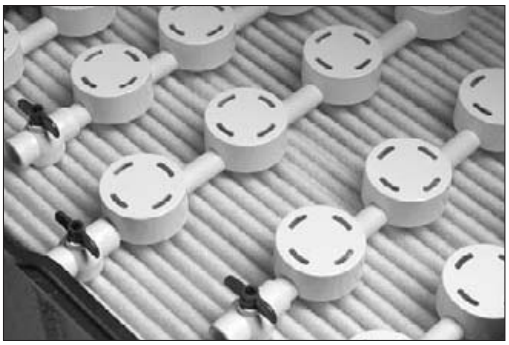
The tank operates as a plug-flow type of reactor (fluid and particles enter and exit the tank in progressive sequence). Wastewater separates into three distinct layers: a floating scum layer, a bottom sludge layer, and a clear zone in between, which is relatively free of large solids. A pump vault with effluent filter located at the outlet end of the tank draws liquid effluent from the clear zone, and the filtered effluent is dosed to the next step in the treatment process . . . the AdvanTex Textile Filter.

Because the AdvanTex Treatment System operates in the recirculating mode, the filtrate from the Textile Filter returns to the processing tank in one of two ways: to the back (outlet end) of the tank in Mode 1 and to the front (inlet end) of the tank in Mode 3. This plumbing configuration affects effluent quality. Effluent quality is also contingent upon a number of other conditions inside the tank:

- strength and characteristics of incoming waste (see "Raw Influent," page 7)
- average flows within design range (typically 40-60 gallons per person per day)
- adequate long-term solids retention for thorough digestion
- watertightness of tank (for proper stratification of incoming waste to prevent treatment short circuiting and hydraulic overloading)
- proper size of tank (for minimum 24-hour hydraulic retention time through the tank's clear zone, at average flow rates and when sludge and scum are developed fully)

If the above conditions are met, you can expect treatment performance per the table on page 7.

# Treatment Process/Performance Expectations
**(continued)**



## AdvanTex Textile Filter

The AdvanTex textile filter provides secondary wastewater treatment. The filter is a sturdy, watertight fiberglass basin filled with an engineered textile material. This lightweight, highly absorbent textile material treats a tremendous amount of wastewater in a small space.

The AdvanTex filter operates in the recirculating mode, just like a recirculating sand or gravel filter, but loading rates are typically 5-20 times higher, for a number of reasons. For one thing, the textile media has a very large surface area—about 5 times greater than that of an equivalent volume of sand. Textile also has a greater void volume (for free flow of oxygen) and greater water-holding capacity.

Wastewater percolates both through and between the textile media. A visible biological film normally develops on the filter medium within a few days. $BOD_5$ and TSS reductions occur almost immediately.

Within the filter, aerobic conditions exist that are ideal for microbes that convert ammonia to nitrate (nitrification). Other conditions exist, too, that result in further nitrogen reduction within the media. Some AdvanTex filters are configured (Mode 3) so that the filtrate recirculates back to the high-carbon, low-oxygen environment at the inlet end of the processing tank, which is ideal for microbes that reduce nitrates to nitrogen gas (denitrification). Harmless nitrogen gas is then released freely back into the atmosphere. The acclimation period for nitrification may range from four to eight weeks, or longer in colder climates.

AdvanTex filtrate effluent quality is dependent upon proper management of the recirc/blend effluent flowing into the filter (which, in turn, is dependent on the conditions described on the previous page). If proper conditions are met, and with typical average daily flows of 40-60 gallons per capita per day, you can expect the following treatment performance:

## Performance Expectations

| | $BOD_5$ mg/L | TSS mg/L | TKN mg/L |
|---|---|---|---|
| **Raw Influent**[1] | 450 | 500 | 70 |
| **Primary Chamber Effluent** | 150 | 40 | 65 |
| **Processing Tank Recirc/Blend Effluent**[2] | 15-40 | 10-20 | —[4] |
| **AXN Filtrate**[3] | 5 | 5 | —[4] |

[1] *Source: Crites & Tchobanoglous. Small and Decentralized Wastewater Management Systems, p. 180, 183, 1998. McGraw-Hill. Based on 50 gpcd.*

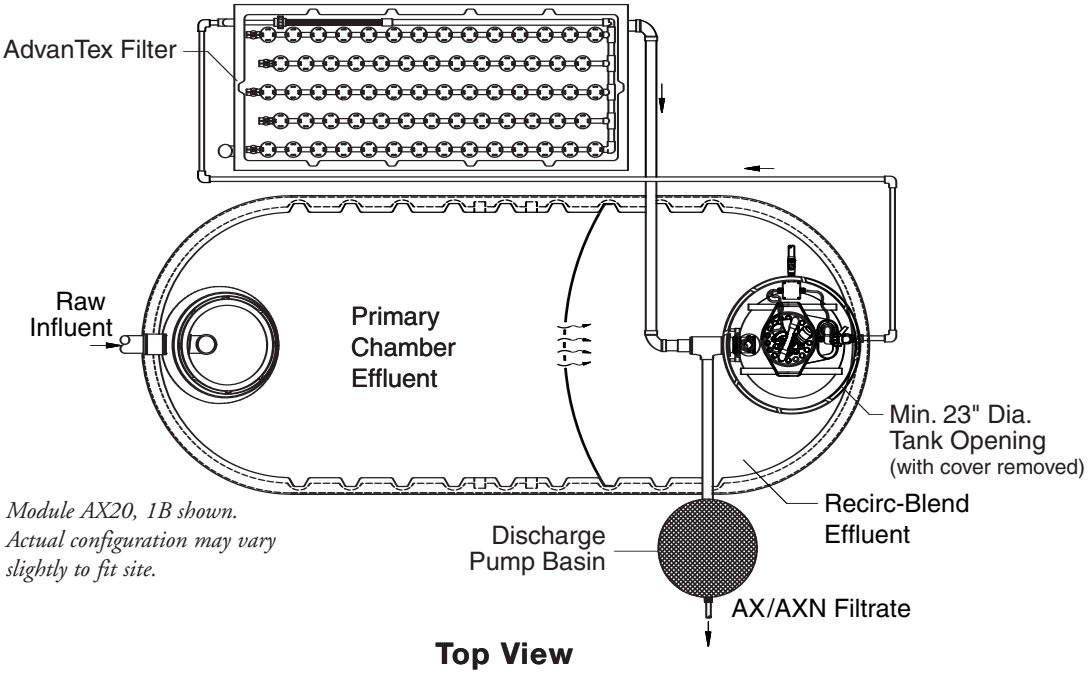
[2] *Will vary with recirc ratios and mode configuration. The numbers here represent a recirc ratio between 2:1 and 4:1 and are derived from Orenco and third-party testing in Mode 1.*

[3] *Actual performance results, based on a six-month accumulative average from NSF (National Sanitation Foundation) testing on the AX20N at 500 gpd, using composite sampling. See page 17 for additional information on treatment performance.*

*Performance and servicing frequencies will tend to vary relative to the mass load being treated. Procedures for treating excessively high loads will require engineering review. For more information, please review AdvanTex Design Criteria.*

[4] *Dependent on treatment system configuration and recirc ratios.*

# Typical Materials List




*Module AX20, 1B shown. Actual configuration may vary slightly to fit site.*

**Top View**

Orenco's AdvanTex Treatment Systems come in multiple models and configurations. Following is a typical materials list (excluding the processing tank) for an AdvanTex AX20 system that requires a pump basin (some do not).

## Processing Tank Access Equipment

Two Access Risers necessary:

One 24" dia., w/Lid

One 30" dia., w/Lid & necessary Grommets

## Treatment System Equipment

PVC Splice Box

Universal Biotube® Pump Vault

Discharge Assembly

Float Switch Assembly

Orenco Pump, 115V

MVP or VCOM AdvanTex AXB Panel, 115V

Recirculating Splitter Valve Assembly

AdvanTex AX20 Filter (7.5' x 3' x 2.5')

w/Vent Assembly

Anti-Flotation Flanges

## Pump Basin Equipment

PVC Pump Basin, 24" dia., w/Lid

PVC Splice Box

Discharge Assembly

Float Switch Assembly

Orenco Pump, 115V

# Tools, Equipment, and Spare Parts List

Many of the recommended maintenance and troubleshooting procedures require specialized tools, equipment, and spare parts. At a minimum, we recommend you keep the following items on hand:

## Tools and Equipment

anemometer (call for information)

beakers or bottles

camera (preferably digital)

calculator

channel lock pliers—6" and 12"

crimping tool—10 to 22 AWG

drill (cordless, with spare batteries, charger)

drill bit set—1/16" to 1/2"

electrical tester (voltage and amperage)

extension cord

flashlight with spare batteries/bulb

funnel

hacksaw with spare blades

hammer

heat gun (torch)

hole saw (vari-bits: 3/4" and 1-3/8")

hose with nozzle and backflow prevention device

pencil

Mirror on a Stick (available from Prototek)

pressure gauge (0 to 100 psi, 0 to 200 psi)

backpack pressure washer (portable)

screwdriver set (straight blade and Phillips)

shovel

SMUG device

snake (building sewer)

squirt-height gauge

stir sticks

tape measure

telephone (for testing dial tone to VeriComm panel)

watch or stopwatch

wire strippers

wrench (24" pipe wrench)

wrench (lid bolt)

30 gal. garbage can

30 gal. garbage bags

## Spare Parts

control panel parts:

— breakers

— contactors

fuses

epoxy

floats

heat shrink tubing

insulated butt connectors

king connectors

lid bolts

PVC fittings (3/4" to 2")

PVC glue/primer

PVC pipe (3/4" to 2")

## Hygiene and Clean-Up

bleach/water solution

hand cleanser

paper towels

protective clothing

eye protection

rubber gloves

towels and rags

## Miscellaneous

Patience and good humor!

# Routine Cleaning & Maintenance Procedures

Orenco Systems requires regular inspection and maintenance of AdvanTex Treatment Systems as a condition of purchase. All activities are to be performed three to six months after system start-up; and an annual field-service inspection, including sampling, is to be scheduled in late spring or in early summer. For AXN systems, there is to be a minimum of four inspections during the first two years, and then annual inspections thereafter.

Following is a list of the routine cleaning and maintenance procedures we recommend or require. Failure to provide required maintenance will void the AdvanTex Treatment System warranty.

Copies of inspection and maintenance reports, along with any additional documentation, must be forwarded to and retained by the Authorized AdvanTex Treatment System Dealer who sold the system. If there is no Dealer, then the documentation must be forwarded to Orenco Systems, Inc., 814 Airway Avenue, Sutherlin, OR 97479, ATTN: Systems Engineering.

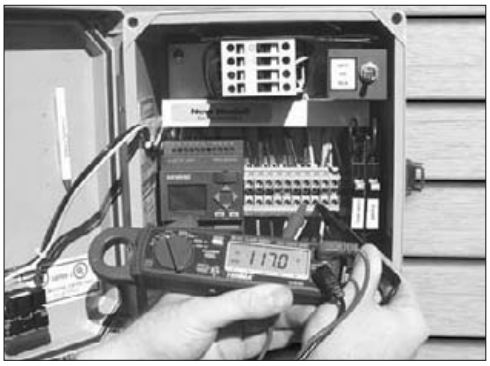
## Control Panel/Pumps/Alarms

**WARNING: Only qualified/certified electricians or service providers should perform maintenance on electrical equipment.**

**1** Check pump operations. Place the MOA switch (Manual, Off, Automatic) to Manual and make sure the pump runs. Then switch back to Automatic and continue to check the automatic operation of the alarm floats, the recirc timer on the floats, the discharge timer on/off, and timer overrides. Refer to the installation, operation, and setting instructions for the control panel that comes with the system. A set of instructions is stored in a plastic pocket on the inside of the panel door.*


*NOTE: Be sure to set the MOA switch back to Auto after testing.*

**2** Check voltages and motor run amps and record them on the Field Maintenance Report Form. If the voltage drop exceeds National Electric Code (NEC) requirements, have an electrician verify the service line and check pump windings.



**3** Verify that the programmable timer settings for all pumps are correct. With MVP panels, you can check timer settings using the digital timer's function keys and large LCD display. With VeriComm® panels (shown here), you can check timer settings online or at the panel, using a laptop computer or PDA. If the timer settings have been changed, the current setting and date of change should be written on your Timer Setting Instructions and Record of System Facts, at the back of this Manual. Place the date and your initials by the recorded change. Appendix 2 gives typical timer settings for households of various sizes.

**If the instructions are missing, you can obtain another set from Orenco's online Document Library, at www.orenco.com, or by calling Orenco at 800-348-9843, or by calling your local AdvanTex Dealer.*

**4** Read and record the elapsed time meter (ETM) and cycle counter (CT) values (from the panel's logic controller or from the Web-based telemetry software) on the Field Maintenance Report Form.

ETMs and CTs are valuable troubleshooting tools if problems occur with the system. ETM and CT data signal high water usage, low water usage or tank leakage, and excessive pumping, among other operating situations.

**5** Confirm operation of audible and visual alarms per the installation, operation, and setting instructions for the control panel that comes with the system.

## Pumping System

Pump systems should be inspected annually to ensure that they are operating properly. Unscrew the stainless steel bolts that fasten the fiberglass lid over the pumping equipment. Remove the fiberglass lid for an inspection that includes these steps:

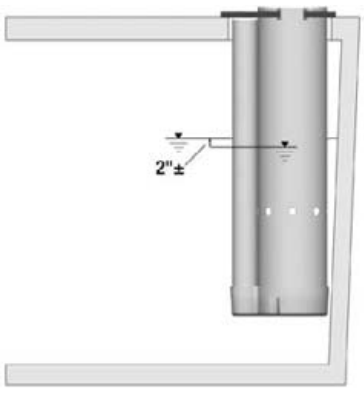
**1** Verify that there are no obvious holes or leaks in the riser or around the perimeter of the riser connection to the tank. Wetness or water marks may be an indication of weeping.

**2** Inspect splice box to ensure lid and connections are secure.

**3** Verify that floats are in good condition and properly secured to the float tree. Verify that float cords are neatly wrapped inside the riser so that they cannot interfere with the operation of the floats.

**4** Verify float operation. With MOA switch in Automatic, simulate system operation by lifting the floats in the same order that the liquid would lift them (bottom first, top last).

**5** Determine whether the Biotube effluent filter needs cleaning by testing the change in the tank's liquid level when the pump is on. Turn the recirc pump on by flipping the MOA switch in the control panel to Manual. **Watch the liquid level inside the screened vault as the pump is running for about 30 seconds to determine if there is any noticeable liquid level differential between it and the tank liquid level.** Return the MOA switch to Auto. When the liquid level difference between the inside and outside of the vault is about two inches or more, or if the low-level alarm is activated, the Biotube cartridge may need to be cleaned.



If the Biotube needs cleaning, do the following:

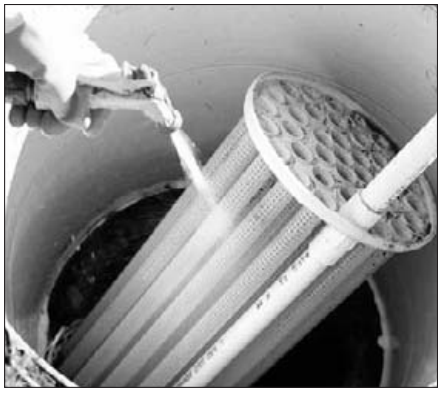
- Turn circuit breaker off at service panel
- Switch MOA and circuit breakers in control panel to "Off"
- Slide Biotube cartridge out of vault
- If necessary, the RSV valve may be removed to allow room in the riser for cleaning the Biotube

  — Pull RSV out of its Quick Disconnect holster (see photo next page) and place it in a plastic trash can

  — Hose off the trash can into the tank after replacing the RSV

**NOTE: Refer to RSV installation instructions for details on how an RSV works.**

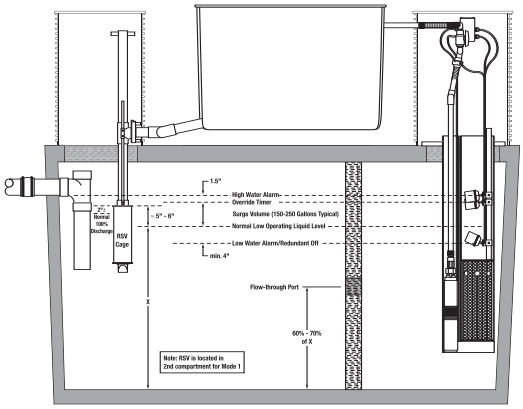
- Hold Biotube cartridge over open inlet of tank or primary compartment
- Carefully spray build-up into tank
- If there are significant solids in vault, remove and clean it too



**6** Pull the pump and place it on a cleanable surface, like the riser lid, or in a plastic trash can. Check the intake screen; wash off particles as necessary. Record the kinds of particles (cigarette butts, hair, lint, gum, kitty litter, cloth wipes, grease build-up, etc.) on the Field Maintenance Report form. Report findings to user (for education).

**7** Visually inspect the Recirculating Splitter Valve and verify that the liquid level in the tank is within the normal range. If low, the ball mechanism could be jammed in the seated position. Remove, disassemble, and inspect. If high, the RSV may require cleaning because it is not making a tight seal when seated. Remove, disassemble, and inspect.

**NOTE: The figure below shows the RSV adjacent to the inlet of the processing tank, which is typical for Mode 3 systems (Mode 1 systems have the RSV in the second compartment of the tank — the Recirc Chamber). To read dimensional specifications, see full-sized drawing in the AX20 Installation Guide.**



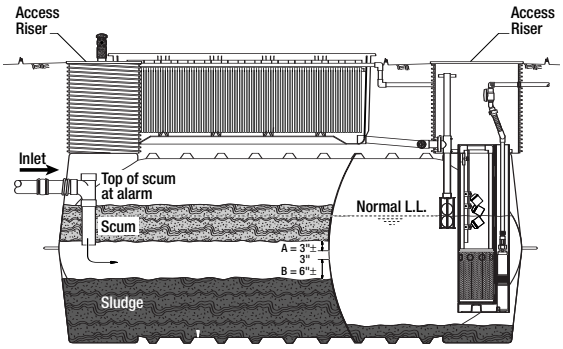

## Processing Tank

**1** If possible, verify no inlet flow when all household appliances are turned off. Access the inlet inspection port for visual verification of lack of flow. If the inlet inspection port is not readily accessible, then listen for trickling water at the access port. This could indicate faulty fixtures or leaky plumbing. Check building sewer cleanout for flow. If faulty plumbing isn't the problem, the

sound of trickling water could indicate I & I (infiltration and inflow) from ground or surface water. In that case, further investigation is necessary.

**2** Inspect the processing tank for the following:

- Liquid depth (should be about 60-70% of the total inside depth of the tank)
- Odor (should be musty, not pungent)
- Color/consistency of scum (should be dark brown with a consistency that varies from dense and crusty to soft and amorphous)
- Effluent characteristics (should be no oily sheen or foam)
- Sludge and scum thickness (records should indicate typical growth accumulation of 1" of scum and 2" of sludge per year for 3-4 occupants)

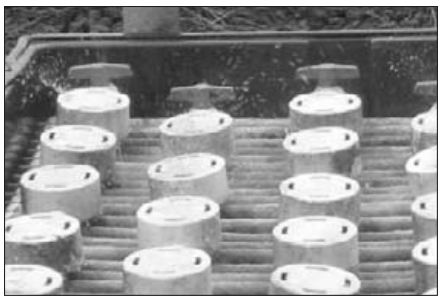



Measurements of solids accumulation help to determine when the septic tank needs pumping. A recommendation for pumping should be made when the bottom of the scum layer is within 3" of the flow-through port of the baffle or when there is an accumulation of sludge to a depth within 6" below the flow-through port. After the first year's measurement of septic tank sludge and scum thickness, measurements need to be taken only about every three years, until the thicknesses approach their maximum depths.

## Textile Filter

**1** Inspect for ponding.* The filter should not be saturated. Effluent should move freely through the media.

**2** While manifold is pressurized, check for proper positioning of orifice shields over each orifice. (See photo, step 3, page 14.)

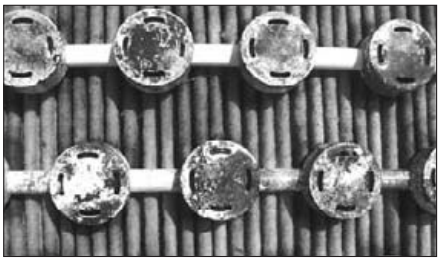


** If there is ponding in the textile filter because of a build-up of oil and grease, scrape a sample of the biomat and have it analyzed by an environmental lab to determine its characteristic. If there is ponding of indeterminate cause, coupled with a pungent odor, it may be necessary to clean the textile media. (Excessive cleaning will retard nitrification. Only clean as often as necessary.) The textile media hangs in individual sheets, and these sheets can be pulled out for cleaning (if necessary). First, remove the Recirculating Splitter Valve.*

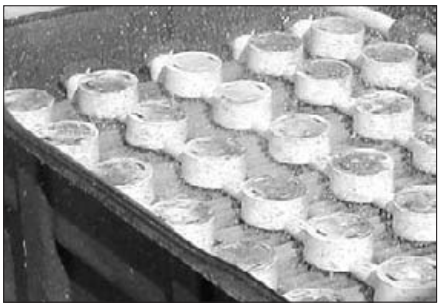
*Use a hose with spray nozzle or **"low-pressure"** pressure-washer, connected to the nearest spigot. Wash the biomat into the underdrain and it will flow back to the tank, as long as the Recirculating Splitter Valve has been removed. When done, replace RSV.*

*Remember: clean filter only if ponding and odor occur.*

**3** Verify that there is equal spray on and under all orifice shields. (Each orifice shield should show signs of organic biomat build-up on and underneath it. In this case, a clean orifice shield top is not better!)



**4** Check for clogged orifices (orifice shields without spray or biomat build-up underneath). You should be able to observe uniform water droplets dancing around orifice shields while dosing.



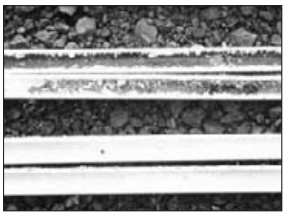
**5** Assess the character and color of the biomat. If it seems appropriate, take a photo and comment on the growth and characteristics of the biological mat under and around the orifice shields. Biomats are natural and normally appear light-brown to dark-brown and gelatinous in texture. If the mat appears too light (yellowish with the texture of lard, wax, or margarine), the grease and oil concentrations should be checked.

If routine DO measurements show a decrease in DO, the biomat may be retarding oxygen transfer. Make sure there is no ponding or ventilation problem, then clean the sheets if necessary.

**6** Check the odor emitting from the filter. If a strong or offensive odor (e.g., smell of rotten eggs, rotten cabbage, etc.) is emitted, measure the DO level in the filtrate and recirculation chamber and adjust the recirc time, if necessary. (Normally, systems will smell musty, earthy, or moldy but not pungent).

**7** Check squirt height and compare residual pressure against the start-up value. This may take longer than just cleaning and flushing the manifold, but will help establish frequency of cleaning.

If the squirt height is 40-50% higher than the start-up value, clean and flush the manifold. (A 50% increase in squirt height signals approximately 18% orifice blockage.) To flush laterals you can run the pump or use a bottle brush or



*Flushing with pump*

*Flushing with pressure washer or bottle brush*

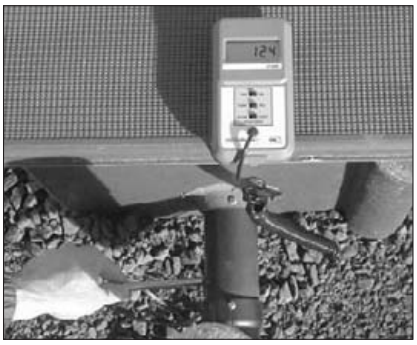
pressure washer. Brushing or pressure washing is best. (When you flush the laterals, biosolids slough into the bottom of the filter, flushing the underdrain at the same time, then return to the tank.) Verify again that all orifices are clear. Re-check squirt height.

**8** Regardless of squirt height, be sure to open the flush valves and run the pump for two-to-three minutes to flush solids and biomass from the pod's underdrain back into the tank. This only takes a couple of minutes and can be done while accomplishing other tasks.

**9** Verify passive ventilation and air flow. Use an anemometer (available through Orenco) to measure the air flowing through the system. 1-3 cubic feet per minute (cfm) is typical. The following chart shows how much airflow is needed* to handle the indicated strength of $BOD_5$ and ammonia:

| Unit | Flow (gpd) | $BOD_5$ (mg/L) | Ammonia (mg/L) | Req. Air Flow (cfm) |
|---|---|---|---|---|
| **AX20** | 500 | 150 | 65 | **0.8** |

**Ultimately, treatment is accomplished and final effluent quality provides the effective measure of treatment performance and capacity. Typical dissolved oxygen levels in the filtrate effluent will range from 3.5 to 5 mg/L DO.*




*In the above photo, the measurement on the meter shows air velocity of 124 feet/minute, which, after mathematical conversion, means that 2.7 cfm (cubic feet/minute) is being drawn through the vent line. Slight atmospheric conditions are more than sufficient to cause two or more air changes to occur every hour.*

Record inlet air flow and outlet air flow, where applicable, to ensure there isn't a large difference between them. A large difference means that leaking or bypassing is occurring. Clean vent pipe as necessary.

## Miscellaneous

**1** Exercise all mechanical valves. Fully open and close valves to ensure they have not failed or become stuck in one position.

**2** Before leaving the site ...

a) Review the Maintenance Checklist to ensure all activities have been performed.

b) Be particularly careful to ensure the following:

- **Valves are back in their recommended positions**

- **Control panel has been set back to automatic and circuit breakers have <u>all</u> been switched back on**


- **Household water lines have been turned back on (if they were turned off earlier in the visit for I & I evaluation)**
- **Lids and lid bolts are properly in place and tightened**

## Documentation

**1** Complete all documentation and submit any required reports to the appropriate parties/ agencies. Be sure to send a copy to the AdvanTex Dealer.

**CAUTION! While providing O&M services, be sure to use proper personal protection equipment, such as rubber gloves and eye protection, as well as protective clothing, to cover parts of the body that will be exposed to wastewater or effluent. When finished, use proper personal hygiene.**

# Effluent Testing Procedures

Orenco Systems recommends regular testing of effluent from AdvanTex Treatment Systems as part of system maintenance. Copies of test results and additional comments/documentation must be forwarded to and retained by the Authorized AdvanTex Treatment System Dealer who sold the system. If no Dealer was involved in the sale, then documentation must be forwarded to Orenco Systems, Inc., 814 Airway Avenue, Sutherlin, OR 97479, ATTN: Systems Engineering.

## Protocol for Sampling, Testing, and Analysis

**Sampling Locations —** For residential systems, sample the discharge filtrate at the filtrate splitter valve. This location is illustrated on your system drawings. Pull the RSV out of its Quick Disconnect holster and lay it on a flat surface. Take the sample at the RSV inlet.

To take a sample that accurately represents the system's effluent quality, do two things:

**1. Wash down, brush, or wipe the RSV inlet before taking the sample so that dislodged solids will not contaminate the sample.**

**2. Don't run the pump manually to force a quick sample. Take the sample during normal system operation.**

**Sampling Schedule —** Typically schedule full-scale annual sampling events for spring.

**Sampling and Storage Methods —** Sampling equipment, minimum sample size, and storage procedures should conform to those recommended in the most current edition of *Standard Methods for the Examination of Water and Wastewater,* American Public Health Association (APHA), available from the Water Environment Federation, 703-684-2400.

**Analytical Methods —** Analytical methods should conform to *Standard Methods,* cited above.

## Routine Tests, Frequencies, and Typical Values

While regional requirements vary, Orenco recommends that the following effluent tests be performed three to six months after system start-up. An annual field-service inspection, including sampling, is to be scheduled in late spring or in early summer. For AXN systems, there must be at least four inspections during the first two years, with sampling once a year as described on the Field Sampling Report Form, and then annual inspections with sampling thereafter.

These tests can be performed in the field; they cost very little and do not require lab work. However, they are very useful in assessing system performance and maintenance.

| Parameter | Methodology | Typical Values* |
|---|---|---|
| Clarity | Visual[1] | Clear (15± NTUs) |
| Odor | Sniff[2] | Non-offensive (musty is OK; rotten egg or cabbage is not OK) |
| Biotube® | Visual | No liquid level differential inside/outside vault<br>Norm: 1-2 year cleaning interval for recirculating systems |
| Oily film | Visual; inside the pump vault | None; no red, blue, green, or orange sheen |
| Foam | Visual; inside tank | None |
| pH | Field[3] | 6-9 |

**Source: These typical values are recommended by various sources. Biotube parameters are based on Orenco research and development.*

*[1] To check for clarity, service providers can carry a sample bottle of typical effluent, to compare against, or can use a portable turbidity meter.*

*Always put effluent sample in a clear glass container or beaker to evaluate clarity. Using a small, removable sticker, write the date and place it low on the beaker.*

[2] *To check for odor, service providers can simply sniff the effluent sample or can use a sulfide measuring packet or an olfactory snifter device for detection of odors. Whenever possible, interview system users about odors.*

[3] *To check for pH, service providers can use litmus paper, a pocket pH meter, or a benchtop pH meter.*


## Supplemental Testing and Typical Values

If effluent is cloudy or smells pungent or if the biomat on the textile filter appears greasy, waxy, or oily, further tests and troubleshooting of the filtrate should be performed. The following filtrate tests provide invaluable information for troubleshooting and diagnosing problems and causes:

| Parameter | Methodology | Typical Values (mg/L) AX[1] | |
|---|---|---|---|
| | | Mode 1 | Mode 3 |
| **$BOD_5$** | Grab | 10± | 10± |
| **TSS** | Grab | 10± | 10± |
| **TN** | Grab | 25± | 5-15± |
| **G&O** | Grab | <1 | |
| **DO** | Field[2] | 2.5-6± | |
| **pH** | Field | 6-8± | |

[1] *AX values are based on Orenco and third-party testing.*

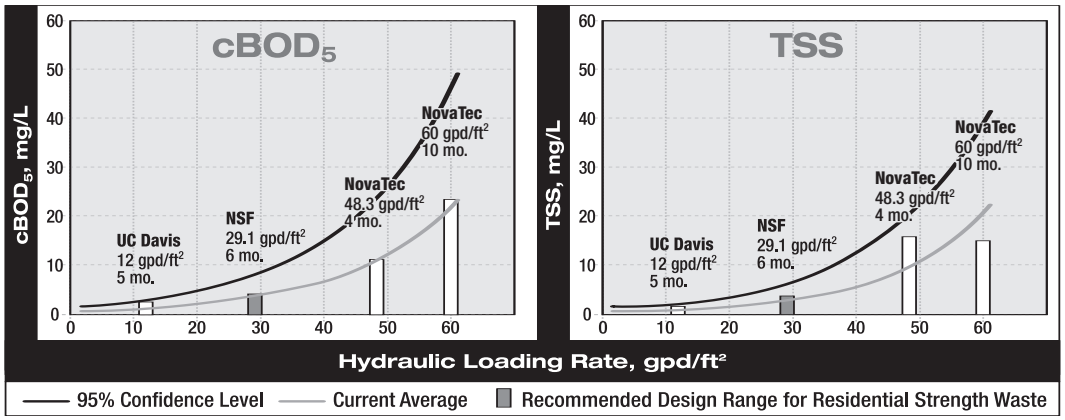
[2] *To check for Dissolved Oxygen, use a DO meter, available from VWR Scientific, Cole-Parmer, or Hach.*

[3] *Typical nitrogen reduction ranges from 60-80%±, with sufficient carbon source and alkalinity.*

## Relationship Between Test Results and Loading Rates

As noted on pages 6-7, filtrate quality is dependent on a number of factors, including influent characteristics and loading rates. The following charts show how low-to-moderate loading rates produce BOD and TSS of <5mg/L, while higher loading rates produce BOD and TSS in the range of 15-25 mg/L.

**Effluent Quality vs. Hydraulic Loading Rates**
**ANSI/NSF Standard 40 and Other Third Party Testing Results**



# Troubleshooting Tips for Operators: Process Treatment

Once you know the typical values for wastewater treatment system performance (see pages 6, 7, 16, and 17), you can be proactive and troubleshoot nontypical process indicators, before system performance is affected.

## Troubleshooting Effluent Quality

If your effluent samples are cloudy and color/turbidity is significantly higher than expected (15 to 30 NTUs), do the following:


*Septic Tank Recirc/Blend Filtrate*

- Perform $cBOD_5$ and TSS tests
- Check the Biotube® filter for clogging
- Check to see if the textile filter smells of chemicals (medication, chlorine, etc.) or has a granular or crusty appearance. (For example, a white crystalline crust could signal that water softener discharge or industrial strength detergents have been flushed into the system.)
- Check to see if the recirc ratio is too high or the pump dose time is too long

If the effluent cBOD is high and TSS low, a large amount of soluble cBOD has not yet been consumed. That would likely be because the recirc ratio is too low for the influent strength or insufficient start-up time has elapsed. Typical organic reduction within the first 24 hours in residential systems is about 75% or greater. As the biomat begins to develop, greater reductions in the soluble cBOD will occur (typically within the first 7-10 days). With a higher influent strength, the soluble cBOD would not be readily removed until the biomat on the media is established.

If none of these troubleshooting steps made a difference, interview the user about system abuse, especially in the area of harmful chemicals, solvents, or strong cleaning agents. **Be sure to check that no water softener backwash is discharging into the processing tank! Water softener backwash can be extremely high in salts, which can disrupt system performance, especially nitrogen reduction processes!**

If no system abuse is uncovered, call Orenco to explore the following design remedies, in this order:

1. Expanded tankage (e.g., additional grease/oil tank)
2. Pretreatment (e.g., additional aeration)
3. Larger filter area (e.g., additional module)

## Troubleshooting Odor

If the tank or textile filter smells like rotten eggs or cabbage:

- Check Dissolved Oxygen levels
- Use a DO meter or Colorimetric Kit
- Note filtrate DO levels that are <2.5 or >6 mg/L

Filtrate DO that's <2.5 mg/L indicates insufficient oxygen. If the filtrate DO is <2.5 mg/L:

- Check filter surface for evidence of clogging
- Check to ensure the pump is working
- Check to ensure ventilation is occurring
- Check to ensure the recirc ratio isn't too low; increase if too low
- Check to ensure influent strength isn't too high (see AdvanTex Design Criteria)
- Check to ensure hydraulic retention time isn't too high

Filtrate DO that's >6 mg/L indicates excessive aeration. If the filtrate DO is >6 mg/L:

- Check to ensure recirc ratio isn't too high
- Check to see if influent flows are below normal
- If influent flows are below normal or recirc ratio is too high, reduce recirc ratio

## Troubleshooting Biotube Filter Clogging

If a visual inspection of the Biotube filter for biomass build-up shows the need for cleaning more often than once every 1-2 years (which is typical for recirculating systems), try the following:

- Verify the pump isn't running too long (typically 3 cycles/hour)
- Ensure the recirc ratio isn't too high
- Verify normal DO levels; if high, reduce recirc ratio
- Check for below normal influent flows
- Check influent Grease & Oil and TSS; if excessive, a review of component sizes may be required

## Troubleshooting Oily Film

All signs of oil or grease anywhere in the system (in the tank, in the vault, on the effluent or textile filter) must be investigated. Ask the system user to identify the probable source:

- Recent change of car oil?
- Canning meat or poultry?
- Excessive use of garbage disposal?
- Excessive use of bath or mineral oils? (Jacuzzi® tub?)
- Excessive use of detergents?

If the system user can't identify the probable source, try the following:

- Sample/test effluent for $BOD_5$ and Grease & Oil
- Sample/test at all process steps, including influent (if possible)
- Label, date, and photograph all samples
- Use standard glass beakers and set samples in front of a common, uniform background, when photographing
- Check biomat accumulation at AdvanTex Filter
- Note if biomat is yellowish and wax-like or lard-like. If so, scrape biomat sample for analysis:
  - — Photograph/document biomat sample
  - — Send to lab with effluent samples

Note: Excessive Grease & Oil (>25 mg/L) is typically a design and management concern with commercial applications.

## Troubleshooting Foam

Foam indicates that microbes are producing excessive gas byproducts. Foam rarely occurs in packed bed filters (and AdvanTex is a packed bed filter). If foam is present:

- Verify the pump isn't running too long
- Ensure the recirc ratio isn't too high
- Ask residents about detergent use

As an aid to troubleshooting, Appendix 2 gives typical timer settings for households of various sizes.

# O&M For Nitrogen Reduction

AdvanTex Treatment Systems do an excellent job of reducing nitrogen, especially in the Mode 3 configuration, where Total Nitrogen* is typically reduced to 10 mg/L ±, with influent TKN of 55-65 mg/L. Because many people purchase AdvanTex for its nitrogen reducing capabilities, and because nitrogen reduction is a complex, many-staged process, it's important to understand the process, its related factors, the signs of effective nitrogen reduction, and how to keep the process optimized.

It's also important to know the Total Nitrogen limits required by the system user's permit. Some regulatory agencies have no requirement; some require a specific percentage reduction of a certain kind of nitrogen (90-95% nitrification of ammonia nitrogen, for example); and some require that Total Nitrogen be reduced to levels at or near drinking water quality at the point of final dispersal.

Finally, because influent characteristics greatly affect the amount of nitrogen reduction possible from any given system, it's vital to know the alkalinity of your waste source and the local/regional norms for organic and ammonia nitrogen.

## The Process

In nitrogen reduction, ammonia is converted to nitrate and then reduced through bacterial action to nitrogen gas, which can be released harmlessly to the atmosphere. Optimum nitrogen reduction requires the following:

- Adequate alkalinity of approximately 250± mg/L or higher (lab test shows levels)
- pH of 6-8. Fixed film microbial processes generally thrive between pH 5.5 and 9. Treatment problems typically result from rapid changes in pH rather than extreme long-term mean values, although long-term levels can result in less efficient process activity
- Filtrate DO level of 2.5-8 mg/L, process tank DO level of <1 mg/L
- Adequate time for the nitrifying bacteria to develop (one to three months)
- Adequate temperature (below 40° F retards the process)
- Good organic removal

For a thorough description of the nitrogen reduction process, see Appendix 1. In residential wastewater, the ammonia level is typically about 60 mg/L and the Total Nitrogen level is typically about 65 mg/L.

## Signs of Effective Nitrogen Reduction

Service providers frequently ask us, "How do I know if my wastewater treatment system is reducing nitrogen?" A thorough description of key indicators is included in Appendix 1. Following is a brief summary:

- Clear, odorless filtrate effluent (a "see and sniff" test is generally considered sufficient)
- Normal-looking biomat on the textile filter (light-brown to dark-brown and gelatinous in texture)

## Additional Filtrate Tests Will Show ...

- Typically, low $BOD_5$ and high clarity
- DO of 2.5-6 mg/L and odorless or odor that is not a nuisance
- Relatively low ammonia and high nitrate levels, since nitrification converts ammonia to nitrate

** Total Nitrogen is the sum of organic and ammonia nitrogen, nitrate nitrogen, and nitrite nitrogen. (TN=ON + NH3-n + NO3-n + NO2-n ... or ... TN=TKN-n + NO3-n + NO2-n)*

## Troubleshooting Nitrogen Reduction

If you suspect that the System is not meeting expectations for nitrogen reduction, troubleshoot each of the critical factors that contribute to optimum nitrogen reduction, to determine a cause.

**Filtrate Alkalinity Too Low —** Available alkalinity determines the degree of nitrification possible for any wastewater treatment system, because it takes 7.14 parts alkalinity to nitrify 1 part ammonia.

If filtrate alkalinity is too low:

- Check the recirc ratio; a high recirc ratio increases alkalinity consumption*
- Check influent TKN or ammonia levels and source alkalinity

If a large quantity of nitrification is required, it may be necessary to add a buffering compound to the system, to raise alkalinity levels.

**Filtrate pH Too Low —** Nitrification is particularly sensitive to pH but tends to thrive at levels between pH 7.2 and 9. The nitrification process releases hydrogen that consumes alkalinity and causes pH levels to drop.

A pH level of <6 retards microbial activity of all kinds, including denitrification. Maintaining an alkalinity of 50 to 80 in the effluent is typically sufficient to maintain pH levels above 5.5. If the filtrate pH level is too low:

- Check influent alkalinity level (pH drops when too much available alkalinity is consumed)
- Check recirc ratios; reduce if too high*
- Ask system user about chemical discharges into the system, including carpet cleaners, chlorine, and photo developing agents

**Filtrate DO Levels Outside Range of 2.5-6 mg/L —** If your filtrate DO is too low (indicating insufficient oxygen), you may experience periodic sulfide odors during dosing events, or perhaps a more lasting smell within the filter pod. Try the following:

- Check for surface clogging/ponding and clean as necessary
- Check air flow through the vent assembly
- Check the recirc ratio; if it's too low (<2:1±) increase as necessary*

If your filtrate DO is too high (indicating excessive aeration), it's likely that excessive recirculation or insufficient hydraulic retention time are factors. Try the following:

- Decrease the recirc ratio*

**High Filtrate Ammonia Levels —** Because ammonia is consumed during nitrification, high ammonia levels are a sign that something is amiss. Try the following:

- Check for surface clogging/ponding and clean as necessary
- Check for sufficient aeration (measure DO)
- Ensure no blockage of air flow into textile filter (indicated by thick biomat development or a build-up of grease and oils)
- Ensure no blockage in the manifold, causing ...
  - — Localized hydraulic overloading, saturation
  - — Short circuiting
- Check for sufficient alkalinity; if insufficient, consider supplemental buffering. Call Orenco Engineering for assistance, if necessary.

**Keep in mind that a recirc ratio that's too high can generate a highly aerobic biomat growth on the pump filter; and a recirc ratio that's too low can tend to liberate periodic odors during dosing events. So search for the optimum ratio (typically between 2 and 4:1)*

**Low Filtrate Nitrate Levels —** Residential packed bed filters normally yield 98+ percent nitrification (ammonia to nitrate). Therefore the ammonia levels in the filtrate should be low and the nitrate levels higher. Some denitrification typically is experienced through the packed bed filter. So the normal nitrate level may vary. Be sure you are familiar with the mode of operation, as some AdvanTex modes are configured to produce lower nitrate levels. If it appears that nitrification is dropping off:

- Check the recirc ratio; adjust as necessary* (high recirc ratios may drive pH too low for effective nitrification/denitrification and low recirc ratios may not provide sufficient aeration)
- Verify incoming ammonia levels
- Check recirc/blend for excessive organic food source (high BOD — see Table, page 7 — may cause greater oxygen demand through the filter, reducing nitrification)

**Adequate Time and Temperature —** Nitrifying bacteria require one to two months to develop, and extremely cold temperatures (below 40° F) retard that process. If the AdvanTex Treatment System has been installed in a very cold climate, nitrification may not "kick in" for several months until warmer temperatures are reached. Typically, a June-September installation provides the necessary temperatures for a 30-60 day nitrification start-up time. Once nitrifiers colonize, they typically continue to nitrify through normal winter conditions. Only in severely cold regions should additional insulation be necessary.

**Keep in mind that a recirc ratio that's too high can generate a highly aerobic biomat growth on the pump filter; and a recirc ratio that's too low can tend to liberate periodic odors during dosing events. So search for the optimum ratio (typically between 2 and 4:1)*

# Field Maintenance Report

**A. Download Report Form**

Service Provider _____ Property Owner _____

Site Address _____ AX Site ID #/Tax ID #/Map ID # _____

**B. Retrieve O&M Info**

- ☐ Timer settings _____
- ☐ Recirc ratio _____
- ☐ Last 3 alarm calls _____
- ☐ Last sludge/scum _____

**C. Perform Field Sampling**

☐ Clarity
Me thod: Visual/Meter
Typical: Clear (15± NTUs)
☐ NTU _____

☐ Odor
Me thod: Sniff
Typical: Musty, earthy, or moldy
☐ Non-offensive ☐ Offensive
☐ Typical ☐ Non-typical
☐ Musty ☐ Sulfide
☐ Earthy ☐ Cabbage
☐ Moldy ☐ Decay

☐ Oily film
Me thod: Visual; inside tank
Typical: None
☐ None
☐ Sheen (red, green, blue, orange)

☐ Foam
Me thod: Visual; inside tank
Typical: None
☐ None
☐ Foam present

☐ pH
Me thod: Field
Typical: 6-9
☐ pH _____

☐ Oxygen
Me thod: Visual/Meter
Typical: 2-6
☐ DO _____

**D. Check Control Panel**

☐ Recirc Pump:
Re st voltage _____
Ru n voltage _____
Ru n amperage _____
☐ Discharge Pump:
Re st voltage _____
Ru n voltage _____
Ru n amperage _____
☐ Audible and visual alarms

**E. Inspect Pumping System**

- ☐ Floats
- ☐ Riser
- ☐ Splice box
- ☐ Float cords
- ☐ Pump

**F. Clean Biotube® Filter/Vault**

- ☐ Biotube Filter
- ☐ Biotube Pump Vault

**G. Measure Sludge/Scum**

- ☐ 1st compartment sludge _____
- ☐ 2nd compartment sludge _____
- ☐ 1st compartment scum _____
- ☐ 2nd compartment scum _____

**H. Inspect/Clean AdvanTex Filter**

- ☐ Odors: ☐ Normal ☐ Pungent
- ☐ Biomat: ☐ Normal ☐ Excessive
- ☐ Bridging/Ponding: ☐ Yes ☐ No
- ☐ Squirt height: _____
- ☐ Orifices
- ☐ Pod bottom
- ☐ Intake vent

**I. Inspect Pump Discharge**

- ☐ Floats
- ☐ Riser
- ☐ Splice box
- ☐ Float cords
- ☐ Pump

**J. Inspect/Service**

- ☐ Disinfection equipment
- ☐ Dispersal equipment

**K. Additional Services Rendered**

- ☐ Changed recirc ratio? ☐ Yes ☐ No
- ☐ Cleaned textile filter? ☐ Yes ☐ No

**L. Summary/Recommendations**

- ☐ Treatment system is performing ☐ Yes ☐ No
- ☐ Additional service needed ☐ Yes ☐ No
  (Before next scheduled visit)
  - ☐ Pump tank? ☐ Yes ☐ No
  - ☐ Other? _____

**Signature** _____

**Date** _____

# Field Alarm Report Form

Service Provider: _____ Alarm Call By: _____

Project Name: _____ Alarm Call Date/Time: _____

Address: _____ Date/Time Responded: _____

AX Site ID#:_____Tax ID#/Map ID#: _____ Total Field Time: _____

AdvanTex® Dealer: _____ Total Travel Time: _____

## Alarm Call Addendum

**Conditions Leading to Call**

☐ Alarm ☐ Odor ☐ Tank Overflow
☐ Noise ☐ Surface Runoff ☐ Sewage Backup
☐ Other: _____

**Odor**

Normal: ☐ Musty ☐ Earthy ☐ Moldy
Pungent: ☐ Sulfide ☐ Cabbage ☐ Decay

Date/Time Discovered: _____ / _____

Method of Detection: _____

**Alarm**

☐ High Liquid Level
☐ Low Liquid Level
☐ Off

**Pump**

☐ On
☐ Off

**Tank Liquid Level**

☐ Normal
☐ High
☐ Low

**Circuit Breaker**

☐ On
☐ Off
☐ Tripped
☐ Switched

**Cause of Malfunction**

Mechanical

☐ Control Panel ☐ Pump
☐ Float Switch ☐ Screened Vault
☐ Hose & Valve ☐ Check Valve
☐ Building Sewer ☐ Service Line
☐ Other: _____

Physical or Process-Related

☐ Power ☐ Back Pressure
☐ Air Bound ☐ Sludge & Scum
☐ Clog ☐ Infiltration/Inflow
☐ Exfiltration ☐ Siphoning
☐ Other: _____

**Repair:** _____

**Replace:** _____

**Notes:** _____

# Appendix 1: The Nitrogen Reduction Process and Key Indicators

## The Process

Nitrogen removal (or "nitrification/denitrification") is a biochemical process in which ammonia is converted to nitrate (nitrification) ($2NH_3$ converts to $2NO_3 + 3H_2O$) and then reduced through bacterial action (denitrification) to nitrogen gas, which can be released harmlessly to the atmosphere.

During the nitrification process, about 9 parts oxygen are consumed in converting 2 parts ammonia to nitrate. Therefore, depending on the concentration of ammonia, a considerable amount of air may be needed. Other processes, like biological (BOD) reduction, may occur simultaneously and further elevate the demand for aeration, especially if the organic level is high.

In an abundance of air, all the aerobic or facultative microbes compete for their share of oxygen. When the organic concentration is high, the microbes that oxidize organic matter, primarily the heterotrophic bacteria, are aggressive and tend to outcompete other microbes for the available free oxygen in solution. The oxidation of ammonia is accomplished by autotrophic bacteria, which do not have as aggressive of a growth rate, so if there isn't an abundance of oxygen, nitrification suffers. Consequently, the nitrification process usually lags until the organic concentration is depleted or until sufficient oxygen is present. At a 2.5:1 BOD/TKN ratio, the nitrifiers may only make up about 10 percent of the microbial population. At 0.5:1 BOD/TKN, the nitrifiers make up about 35 percent of the population.

In a filtering process, the filter column must be deep enough, or the filter media must be efficient enough at filtering organic particles, to deplete organic concentrations to a level in which a sufficient population of nitrifiers will be sustained. The physical (dimensional) features of the filter will vary depending on the media's characteristics — void ratio, moisture holding capacity, and effective surface area per unit volume ratio. Tankage, surge capacity, application rates, and loading characteristics are other design considerations that play a role in the sizing of the filter unit.

## Performance Indicators

To judge the nitrogen-reducing performance (or potential) of any wastewater treatment system, be sure to check the following performance indicators:

**Clear, Odorless Effluent —** Simple, "see and sniff" tests can be performed easily in the field. Effluent from packed bed filters (recirculating textile filters, recirculating sand filters, intermittent sand filters) that are performing well should be clear (with turbidity ≤20 NTUs±) and odorless.

**Tests for Ammonia and Nitrate Nitrogen —** If your system is oxidizing ammonia to nitrate (nitrifying), lab tests should measure relatively low ammonia levels and relatively high nitrate levels in the filtrate. Because nitrification responds to many and varying conditions within the aerobic treatment processes, ammonia and nitrate nitrogen levels in the filtrate are the most ideal constituents to watch for any changes in performance. Start-up times can be plotted, optimum recirc ratios can be gauged, cleaning frequencies can be predicted, and nonvisible clogging or saturation detected by watching either of these constituents.

Typical nitrification in single-family residential systems is expected to be in the 98-99% range. You'll want to investigate if the process appears to degrade by 5 percentage points or more.

**BOD —** The nitrification process requires oxygen, which is why nitrification is enhanced when BOD is extremely low. Measures of filtrate BOD should be <15 mg/L, although higher BOD may not necessarily correlate with low levels of nitrification.

Typical influent characteristics are shown on page 7. When $BOD_5$ is high, there is a greater organic demand for oxygen, which may hamper the nitrogenous demand for oxygen. Increasing the recirc ratio should help establish oxygen balance.

**Dissolved Oxygen —** Dissolved oxygen also provides critical information with which to diagnose how well a system is performing. Measures of Dissolved Oxygen should be in the range of

2.5 to 6 mg/L. If the DO level drops, the degree of nitrification will normally drop as well, which could be a sign of blinding or saturated flow conditions — anything that might inhibit free air from flowing into the system. (Though it's quite possible to have low filtrate DOs and still have high effluent quality, as measured by BOD and TSS levels.)

**Biological Growth on Filter —** With "fixed film" treatment systems, biological growth on the filter media is natural. The biomat should appear light-brown to dark-brown in color and gelatinous in texture.

**Influent Characteristics —** Influent characteristics (see page 7) will greatly affect the amount of nitrogen reduction that is possible from any wastewater treatment system. High solids and/or fats and cooking oils increase the oxygen demand and accumulation of material on and within the media, affecting the available oxygen for nitrification.

**pH —** For normal residential nitrogen loads, pH is typically maintained between 6 and 8.

**Alkalinity —** The nitrification process releases hydrogen ions into solution, which tends to lower the pH level. Alkalinity is essential for nitrification. For each part ammonia that is nitrified, 7.14 parts alkalinity are consumed (buffering the acidity caused by the release of hydrogen ions). Consequently, if the degree of nitrification is less than expected, it could simply be a lack of sufficient alkalinity to support more. Typical residential nitrification requires alkalinity above 250± mg/L for recirculating processes and double that for single pass processes. *Many wastewater streams do not have sufficient alkalinity to support complete nitrification.*

Wastewater streams without sufficient alkalinity to support complete nitrification may, depending on the type of process, cause a depletion in the alkalinity to the point where its ability to buffer stops. The pH correspondingly drops to a level that retards the microbial activity (<6±). Recirculating the effluent helps, since half the alkalinity can be restored in the recirc or process tank, wherever denitrification occurs (and adjusting the recirc ratios may also bring the pH back to preferred operating levels). But wastewater streams that are alkalinity-starved can't provide for 100% nitrification.

The use of low flush fixtures requires special consideration. Low flush fixtures tend to reduce hydraulic loads, which causes elevation of wastewater constituents (i.e., higher concentrations of BOD, TSS, TKN, etc.). In this case, the available alkalinity in the water supply may not be adequate to accomplish the full level of nitrification desired.

These constraints exist for all wastewater treatment operations, regardless of whether the operation involves a suspended growth contact stabilization process or an attached growth packed bed filter. Packed bed systems will perform better, especially if they have a large attached growth surface area per unit volume ratio, because the micro-sites near the attached side of the biomat, where denitrification typically occurs, return some of the alkalinity. Textile packed bed filters, because of their large surface area per unit volume ratio, tend to perform even better. Nevertheless, additional buffering may be necessary to accomplish the level of nitrification desired. In low alkalinity conditions, pH adjustment can be made with the addition of Quick or Hydrated lime, soda ash, or caustic. (Note: at process points preceding sedimentation zones, lime adjustment — buffering — would be preferred. Soda ash and caustic both contain sodium, which is a dispersant.)

# Appendix 2: Timer Settings

The following chart shows recommended timer settings for a new system.

| RESIDENTS | TIME ON (SEC) | TIME OFF (MIN) | NOTES |
|---|---|---|---|
| 2 | 10 sec (.17 min) | 20.00 | |
| 3 | 15 sec (.25 min) | 19.75 | |
| 4 | 20 sec (.33 min) | 19.45 | |
| 5 | 25 sec (.42 min) | 19.70 | |
| 6 | 30 sec (.50 min) | 19.50 | |

As you gain experience with a system, you may conclude that you need to make adjustments, sometimes significant ones. This worksheet is intended to help you determine appropriate start-up timer settings (Pump ON, pump OFF) for a single-pod AX20 system. Typical values and ranges are provided for each parameter. If you have any questions or if your values fall outside the desired ranges on this worksheet, contact your Dealer.

| PARAMETER | | TYPICAL VALUES | NOTES |
|---|---|---|---|
| | Number of people | 3 | Range of 2 to 8 people. |
| | Water usage per person | 50 gpd (190 L/d) | Typical daily average is 50 gal. (190 L) per person. |
| $Q_i$ | Actual daily flow (total) | 150 gpd (570 L/d) | (Number of people) x (water usage per person). |
| $R_b$<br>$R_f$ | Return recirculation ratio<br>Filter recirculation ratio | 3 : 1<br>4 : 1 | You can adjust this ratio (return flow to forward flow) up or down depending on system performance. (Range of 2 to 6.) |
| | Total daily flow to AX20 | 600 gpd<br>(2280 L/d) | (Actual daily flow) x (return recirculation ratio + 1). Must be ≤ 3000 gpd (11,370 L/d). Actual flow should not exceed 500 gpd (1895 L/d). (500 gpd x 6:1 $R_b$ = 3000 gpd) |
| $Q_d$ | Actual pump dose rate | 33.3 gpm<br>(126 L/min) | Determine this value by field-testing or by using Orenco's PumpSelect™. Start at the low end. |
| $T_d$ | Pump ON cycle time (dose) | 0.25 min | Select a value between 0.17 minutes (10 seconds) and 0.75 minutes (45 seconds). |
| $T_r$ | Pump OFF cycle time (rest) | 19.75 min | See Pump OFF equation below. |

| PUMP OFF EQUATION | EXAMPLE |
|---|---|

Plugging in the above values and rounding, we get the following:

After you determine your Pump ON and Pump OFF times, double check to make sure your start-up settings fall within the cycle time (CT) range, below. If they don't, make adjustments per the "Note."

| ADDITIONAL PARAMETERS | | TYPICAL VALUES | NOTES |
|---|---|---|---|
| CT | Cycle time | 20.0 min | Low flow applications may result in cycle times of an hour or more, which can cause the media to dry out or odors to develop in the recirc tank. If CT is much more than 30 minutes, consult your Dealer or Orenco for suggested adjustments. |
| | Pump cycles per day | 72 cycles | 1440 min/day ÷ (OFF cycle time + ON cycle time). Must not exceed the pump's maximum rated cycles per day of 300 cycles per day. |
| | Gallons per cycle | 8.3 gal.<br>(31 L) | With 68 orifices and using the $T_d$ range recommended above, you will maintain the recommended 0.08 to 0.25 gal. (0.45 to 0.95 L) per orifice per dose. |

# Record of System Facts

**(Record in Pencil)**

Property Address

Property Owner Name(s)

Property Owner Phone

Property Owner E-Mail

Start-Up Date

AdvanTex Model #

AdvanTex Serial Number (on filter pod)

Control Panel Model #

Float Model #(s)

Pump(s) Model #(s)

Pump(s) Design Specifications:

_____ gpm _____ gpm

Design Flow

Tank(s) Size(s)

Recirc Ratio (start-up)

Recirc Timer Settings

Discharge Timer Settings (when applicable)

Initial Squirt Height

Dispersal Method

*Distributed by:*

Dealer Name

Dealer Phone

Engineer Name

Engineer Phone

Installer Name

Installer Phone

Service Provider Name

Service Provider Phone

Regulatory Authority

Permit # (if applicable)

Contact Name

Contact Phone

*AdvanTex® Treatment System AXN Models meet the requirements of NSF-ANSI Standard 40 for Class I Systems.*

**Orenco Systems®**
Incorporated

*Changing the Way the World Does Wastewater®*

**800-348-9843**
**www.orenco.com**

**AIM-OM-ATX**
**Rev. 3.4, © 2/07**
**Orenco Systems® Inc.**

# AdvanTex® FAQ

Orenco Systems®
Incorporated
1-800-348-9843

***Q. Since one of your AdvanTex models received NSF approval under the NSF/ANSI Standard 40 testing protocol (which is primarily used for aerobic treatment units), does that mean your product is an ATU?***

A. Not in the way the term "ATU" is currently understood. ATU is an acronym for "Aerobic Treatment Unit," but it has evolved into industry shorthand for technologies that use a "suspended growth" treatment process. (This process involves pumping air into a liquid medium, where waste-eating microbes are grown, "suspended" in the liquid). By contrast, AdvanTex Treatment Systems are packed bed filters that use an "attached growth" treatment process. (Attached growth uses physical filtration devices on which waste-eating microbes are grown.)

Since both these treatment processes use oxygen, technically they are both Aerobic Treatment Processes; the differences in performance, however, are significant. Suspended growth processes in residential applications are typically on-demand, gravity-discharge and rely solely on complete mixing and the biochemistry of aeration to treat waste. Any disruption of this delicate biochemical process (peak loads, power outages) can cause untreated waste to gravity right through the unit and into the drainfield.

In contrast, attached growth packed bed filters like AdvanTex are typically time-dosed, pump discharge and use both biochemical AND physical removal treatment processes. So they can handle peak loads reliably and no untreated waste is bypassed under any circumstances. Attached growth packed bed filters have other benefits as well: quick start-ups, low O&M costs, and low power consumption.

***Q. Are your AdvanTex textile filters a new technology?***

A. Yes, but the textile filter treatment process is based on a proven technology: packed bed filters. At the end of this section, we've included a chapter on "Intermittent and Recirculating Packed Bed Filters" from the definitive textbook on decentralized waster water treatment: *Small and Decentralized Wastewater Management Systems* (Crites and Tchobanoglous, 1998). In that chapter, on page 714, there is a brief summary of the history of packed bed filters: "Early Development and History of Use." We've also included an article that discusses the use of textile media in wastewater treatment: "Performance of Packed Bed Filters," (T. Bounds, E. Ball, H. Ball, 2000). Additional documentation can be provided at your request.

***Q. How can you take a 360-square-foot packed bed filter, like a sand or gravel filter, and compress it into just 10 to 30-square-feet?***

A. Because of the increased surface area of the textile media, combined with its large void spaces and its water holding capacity. This is a treatment process based on sound science, incorporating fundamental principles of physics (mass loading), chemistry, and biology.

***Q. Why does textile have such a bigger surface area and void space than sand or gravel?***

A. Because the textile media is fibrous, not solid. With a solid grain of sand or gravel, only the outside surface area is available for the attachment of bacteria. With textile, the surface area around each and every fiber is also available. As a result, the surface area is more than 5 times greater than that of sand media.

***Q. According to your research, you're loading your textile filters as high as 60 gpd / $ft^2$. That's much, much higher than the typical loading rates for intermittent sand filters (1.25 gpd / $ft^2$) and recirculating sand filters (5 gpd / $ft^2$). How can you do that?***

A. There are a number of reasons why. The **first** reason is the larger surface area of the textile media, as noted in the previous question. The larger surface area gives greater colonies of bacteria an interface for oxygen exchange.

The **second** reason is the greater void space in textile media, which is about 5 times greater than that of sand. Void space does two things; it allows for a free flow of oxygen and provides a larger void for solids accumulation. Free flow of oxygen combined with a large interface for oxygen transfer optimizes bacterial digestion. The SAR (Solids Accumulation Rate) is a measurement of how long a filter will last before it clogs with organic and inorganic particles, as well as grease and oil. The greater the SAR, the longer life a filter will have.

The **third** is the greater water holding capacity of the textile media. An increased water holding capacity equates to a more sustainable environment for bacteria to live in. A poor water holding capacity creates an environment where bacteria dry out and sloughing can occur. Finally, water-holding capacity is important, because high water-holding capacity gives bacteria the time to digest organic waste. Textile media has about five times the water-holding capacity of sand.

It's important to note that these factors combine to allow substantial increases in loading rates. For example, one cubic foot of ISF sand media has about twice as much surface area as one cubic foot of RSF sand media. ISF sand media also has a better water holding capacity. However the loading rate of the RSF sand media is actually five times higher due to the greater void space. If we compare the sand medias, the ISF has more surface area and greater water holding capacity while the RSF has greater void spaces.

To conclude, textile media optimizes treatment with a large surface area, greater void space, and increased water holding capacity, which allows the combination of the best attributes of the ISF and the RSF into one compact, packed bed filter.

***Q. How long will the media last?***

A. The media should last indefinitely under normal domestic discharge conditions. The synthetic fibers are made of durable and biodegradation-resistant polymers.

***Q. Will the media need to be discarded or replaced, and, if so, how frequently?***

A. No. The media hang in aligned sheets. This style is built to accommodate solids accumulation, and, under normal conditions, should last indefinitely. It can be easily maintained by cleaning with a hose or pressure washer. We expect the nominal interval between cleanings to be several years, although, as with all biochemical processes, that will depend on the mass loading of the system. Also, the biomat that develops on the media is where treatment occurs, so excessive cleaning does not assure improved performance; maintenance should be done by a knowledgeable and qualified operator.

***Q. Occasionally I see references to an "RX Series" textile filter. But most of your material discusses the "AX Series." What's the difference between the AX and the RX?***

A. The AX Series uses aligned sheets of hanging textile material, while the RX Series – an earlier version of the product – uses random chips (aka "coupons") of textile material. The AX Series is a refinement of the technology and is the one we are now promoting except in regions that have approved the RX Series but have not yet approved the AX Series.

# HOMEOWNER'S MANUAL

## Onsite Wastewater Collection & Treatment Systems

# How to Take Care of Your Wastewater System


**Orenco Systems®**
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*Changing the Way the World Does Wastewater®*

**800-348-9843**
**www.orenco.com**
**www.vericomm.net**

# How to Take Care of Your Wastewater System

## *Congratulations!*

Your home includes reliable, carefully engineered equipment — manufactured by Orenco Systems®, Inc. — for the collection and/or treatment of household wastewater.

When properly designed and installed, onsite wastewater treatment does a terrific job of decomposing household waste and recycling precious water resources. Our systems use little energy and frequently outperform municipal sewage treatment plants. The treated effluent is often returned harmlessly to the soil, where it receives final polishing and filtration for groundwater recharge. There's no degrading of our nation's rivers and oceans . . . which is so often the case with municipal sewage.

As with any engineered system, such as your car or your heat pump, your onsite wastewater system will work better and last longer if it is regularly maintained by a qualified service provider. Your service provider should be present during installation, so he or she is familiar with your system, especially those service lines, conduits, and connections that get buried.

And your service provider should have a copy of this manual. It's available on our Document Library, at www.orenco.com. Or call 800-348-9843 and we'll send you another.

Your system will also work better and last longer if you learn what can go into it — and what can not. Little effort is required. Just read and practice the "do's and don'ts" that follow. Every member of your household should be familiar with these. And if you have guests who want to "help out in the kitchen," be sure to tell them, too. With this preventive maintenance, along with periodic inspections, your onsite wastewater system should function for decades. And you'll save water and energy, too!

There's a place on the back of this Homeowner's Manual to record "Important System Facts." If those have not been filled in for you, please record those now, before you file or shelve this manual. And give a copy of these facts to your service provider, especially if your service provider changes. You'll be glad you did.

# Do's and Don'ts for INSIDE the House

There are a number of do's and don'ts that will help ensure a long life and minimal maintenance for your system. As a general rule, nothing should be disposed into any wastewater system that hasn't first been ingested, other than toilet tissue, mild detergents, and wash water. Here are some additional guidelines.


**Don't** flush dangerous and damaging substances into your wastewater treatment system. (Please refer to the "Substitutes for Household Hazardous Waste," on the next panel.) Specifically, do not flush . . .

- Pharmaceuticals
- Excessive amounts of bath or body oils
- Water softener backwash
- Flammable or toxic products
- Household cleaners, especially floor wax and rug cleaners
- Chlorine bleach, chlorides, and pool or spa products
- Pesticides, herbicides, agricultural chemicals, or fertilizers

**Do** keep lint out of your wastewater treatment system by cleaning the lint filters on your washing machine and dryer before every load. Installing a supplemental lint filter on your washing machine would be a good precautionary measure. (This normally takes just a few minutes. Lint and other such materials can make a big difference in the frequency and cost of pumping out your primary treatment tank.)


**Don't** use special additives that are touted to enhance the performance of your tank or system. Additives can cause major damage to other areas in the collection system. The natural microorganisms that grow in your system generate their own enzymes that are sufficient for breaking down and digesting nutrients in the wastewater.


**Don't** ignore leaky plumbing fixtures; repair them. A leaky toilet can waste up to 2,000 gallons of water in a single day. That's 10-20 times more water than a household's typical daily usage. Leaky plumbing fixtures increase your water bill, waste natural resources, and overload your system.


**Don't** leave interior faucets on to protect water lines during cold spells. A running faucet can easily increase your wastewater flow by 1,000 to 3,000 gallons per day and hydraulically overload your system. Instead, properly insulate or heat your faucets and plumbing.

**Do** collect grease in a container and dispose with your trash. And avoid using garbage disposals excessively. Compost scraps or dispose with your trash, also. Food by-products accelerate the need for septage pumping and increase maintenance.

**Do** use your trash can to dispose of substances that cause maintenance problems and/or increase the need for septage pumping. Dispose of the following with your trash:

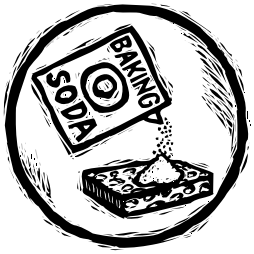
- Egg shells, cantaloupe seeds, gum, coffee grounds
- Tea bags, chewing tobacco, cigarette butts
- Paper towels, newspapers, sanitary napkins, diapers, kitty litter, candy wrappers
- Rags, large amounts of hair

## Do's and Don'ts for INSIDE the House

**Don't** use excessive amounts of water. Using 50 gallons per person per day is typical. If your household does not practice any of the "water conserving tips" below, you may be using too much water.

**Do** conserve water:

- Take shorter showers or take baths with a partially filled tub. Be cautious about excessive use of large soaking tubs.
- Don't let water run unnecessarily while brushing teeth or washing hands, food, dishes, etc.
- Wash dishes and clothes when you have a full load.
- When possible, avoid doing several loads in one day.
- Use water-saving devices on faucets and showerheads.
- When replacing old toilets, buy low-flush models.




**Do** use substitutes for household hazardous waste. Replace the following hazardous products with products that are less environmentally harmful. The hazardous cleaners are listed below, followed by the suggested substitute.

**Ammonia-based cleaners:**
Sprinkle baking soda on a damp sponge. For windows, use a solution of 2 tbs white vinegar to 1 qt water. Pour the mixture into a spray bottle.

**Disinfectants:**
Use borax: 1/2 cup in a gallon of water; deodorizes also.

**Drain decloggers:**
Use a plunger or metal snake, or remove and clean trap.

**Scouring cleaners & powders:**
Sprinkle baking soda on a damp sponge or add 4 tbs baking soda to 1 qt warm water. Or use Bon Ami; it's cheaper and won't scratch.

**Carpet/upholstery cleaners:**
Sprinkle dry cornstarch or baking soda on, then vacuum. For tougher stains, blot with white vinegar in soapy water.

**Toilet cleaners:**
Sprinkle on baking soda or Bon Ami; then scrub with a toilet brush.

**Furniture/floor polishes:**
To clean, use oil soap and warm water. Dry with soft cloth. Polish with 1 part lemon juice and 2 parts oil (any kind), or use natural products with lemon oil or beeswax in mineral oil.

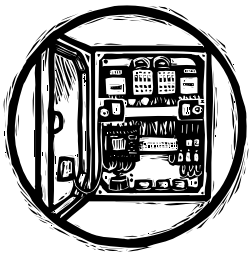
**Metal cleaners:**

- Brass and copper: scrub with a used half of lemon dipped in salt.
- Stainless steel: use scouring pad and soapy water.
- Silver: rub gently with toothpaste and soft wet cloth.

**Oven cleaners:**
Quickly sprinkle salt on drips; then scrub. Use baking soda and scouring pads on older spills.


**Laundry detergents:**
Choose a liquid detergent (not a powder) that doesn't have chlorine or phosphates.

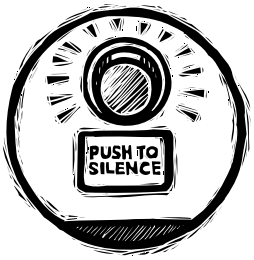
## At the Control Panel



**Do** locate your electrical control panel where it will be protected from potential vandalism and have unobstructed access.

**Do** familiarize yourself with the location of your wastewater system and electrical control panel. Refer to the panel's model and UL number (inside the door panel) when reporting a malfunction in the system.

**Do** take immediate action to correct the problem in the event of an alarm condition. Call your system operator or maintenance company immediately whenever an alarm comes on. (It sounds like a smoke alarm.)




**Do** remember that the audible alarm can be silenced by pushing the lighted button located directly above the "Push to Silence" label on the front of the electrical control panel. With normal use, the tank has a reserve storage capacity good for 24-48 hours.

**Don't** turn off the main circuit breaker to the wastewater pumps when going on vacation. If there is any infiltration or inflow into the system, the pumps will need to handle it.

## IMPORTANT! CAUTION!

Only a qualified electrician or authorized installer/operator should work on your control panel. Before anyone does any work on either the wiring to the level control floats and pumps in the vault or on the control panel itself, it is imperative to first switch the isolation fuse/breaker and the circuit breakers in the panel to the "Off" positions, then switch "Off" the power to the system at the main breaker!

# Do's and Don'ts for OUTSIDE the House


**Don't** enter your tank. Entering an underground tank without the necessary confined space entry training and procedures can result in death from asphyxiation or drowning. Keep children away from tank openings if lids are off or lid bolts are removed.

**Do** keep the tank access lid fastened to the riser at all times with stainless steel lid bolts. If the lid or riser becomes damaged, BLOCK ACCESS TO THE TANK OPENING, IMMEDIATELY.

Then call your service provider to repair it. If you or your service provider needs replacement bolts, call Orenco at 800-348-9843.


**Don't** dig without knowing the location of your wastewater system. As much as possible, plan landscaping and permanent outdoor structures before installation. But easily removable items, such as bird baths and picnic tables, are OK to place on top of your system.


**Don't** drive over your tank or any buried components in your system, unless it's been equipped with a special traffic lid. If the system is subject to possible traffic, put up a barricade or a row of shrubs.


**Don't** dump RV waste into your wastewater system. It will increase the frequency of required septage pumping. When dumped directly into the pumping vault, RV waste clogs or fouls equipment, causing undue maintenance and repair costs. (Also, some RV waste may contain chemicals that are toxic or that may retard the biological digestion occurring within the tank.)

**Don't** ever connect rain gutters or storm drains to the sewer or allow surface water to drain into it. And don't discharge hot-tub water into your system. The additional water will increase costs, reduce the capacity of the collection and treatment systems, and flood the drainfield. It can also wash excess solids through the tank.

**Do** make arrangements with a reliable service person to provide regular monitoring and maintenance. Place the service person's phone number on or in your control panel!

**Do** keep a file copy of your service provider's sludge and scum monitoring report and pumpout schedule. This information will be beneficial for real estate transactions or regulatory visits.

**Do** keep an "as built" system diagram in a safe place for reference.

# HOMEOWNER'S MANUAL

## Onsite Wastewater Collection & Treatment Systems

**Do** keep accurate records of maintenance and service calls. Make sure whoever services your tank keeps a complete record, and ask for a copy for your records.


**Orenco Systems®**
Incorporated

*Changing the Way the World Does Wastewater®*

**800-348-9843**
**www.orenco.com**
**www.vericomm.net**


## IMPORTANT SYSTEM FACTS

### Distributor or Dealer:

Please fill out the following important information before giving out this Homeowner's Manual:

*Distributor/Dealer Name*

*Distributor/Dealer Address*

*Distributor/Dealer Phone Number(s)*

*Authorized Service Provider Name*

*Authorized Service Provider Phone Number(s)*

*Authorized Installer Name*

*Authorized Installer Phone Number(s)*

*Engineer Name (if applicable)*

*Engineer Phone Number(s)*

*Regulatory Agency*

*Regulatory Contact Name*

*Regulatory Contact Phone Number(s)*

*Permit # (if applicable)*

*Property Address*

*Property Owner Name(s)*

*Start-Up Date*

*Control Panel Model # and UL #*

*AdvanTex® Model # (if applicable)*

*AdvanTex® Serial # (if applicable)*

NSF/ANSI STANDARD 40

*AdvanTex® Treatment System AXN Models meet the requirements of NSF-ANSI Standard 40 for Class I Systems.*


ABR-OM-1
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# Performance of Textile-Based Packed Bed Filters

Terry R. Bounds P.E.*

## Abstract

Small and decentralized wastewater systems may range from individual onsite systems to complete cluster systems. Among the many benefits of onsite and cluster systems is their ability to treat *septic tank* effluent to ***advanced wastewater treatment*** standards (AWT) or better. Many onsite technologies do it more reliably, more affordably, and with considerably less environmental impact than centralized sewers.

For the past couple of decades, packed bed filters (PBFs) — such as single-pass sand filters and recirculating sand and gravel filters — have successfully provided consistent and reliable treatment for small to medium wastewater flows. Textile-based packed bed filters, incorporating an engineered treatment medium, have greatly expanded packed bed technology options by incorporating a manufactured media that is easily serviced and capable of producing high quality effluent. The effluent quality produced by these units is consistently superior to that discharged by the majority of our nation's municipal treatment facilities and is ideal for many water-reuse applications.

Keywords: textile, packed bed filter, decentralized, primary treatment, secondary treatment, advanced wastewater treatment, dispersal, water reuse

## Introduction – Packed Bed Filter Technology

Packed bed filters (PBFs) incorporating naturally occurring treatment media such as sand and gravel have been used successfully for treating small to medium volume wastewater flows for decades. These filters produce high quality effluent that is superior to that discharged by the majority of our nation's municipal treatment facilities. Over the past three decades, two types of packed bed sand filters have been most commonly used—the single-pass filter and the recirculating filter. Single-pass sand filters, as illustrated in Figure 1, are capable of treating septic tank effluent to advanced wastewater treatment (AWT) levels or better.

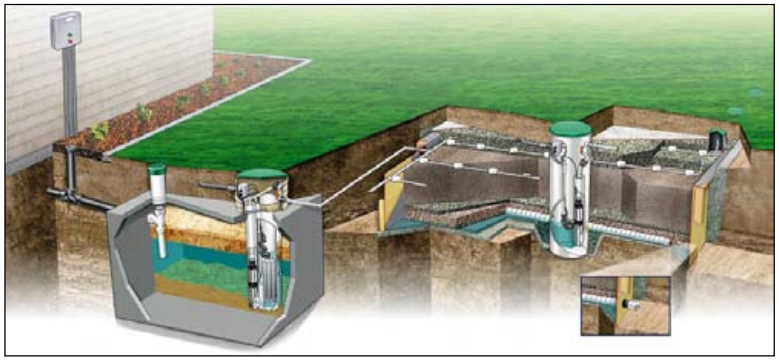


**Figure 1: Single-pass sand filter (ISF)**

* Executive Vice President, Orenco Systems, Inc., Sutherlin, Oregon

The following effluent characteristics are typical averages achieved by single-pass residential sand filters using "washed" ASTM C-33 concrete aggregate with less than 2 percent fines passing the 100 sieve:

**$cBOD_5$:** 5 mg/L
**TSS:** 5 mg/L
**$NO_3$-n:** 30 mg/L

Single-pass sand filters have typically been used in onsite applications for single-family homes or small commercial/office facilities.

Single-pass filters have been most successful when the influent has received primary septic tank treatment and screening with effluent filters to sufficiently ensure that the effluent characteristics applied to the sand filter do not exceed the typical criteria shown in Table 1:

**Table 1: Typical Primary Treated and Screened Residential Wastewater Strengths**

| | Average<br>*mg/L* | Weekly Peak<br>*mg/L* | Rarely Exceed<br>*mg/L* |
|---|---|---|---|
| **$BOD_5$** | 130 | 200 | 300 |
| **TSS** | 40 | 60 | 150 |
| **TKN–n** | 65 | 75 | 150 |
| **G&O** | 20 | 25 | 25 |

With higher influent strengths, maintenance may increase, although with a diligent service and monitoring program, performance is not expected to suffer. Typical single-pass sand filter design criteria are:

| Type of Operation | Design Loading Rate<br>*$gpd/ft^2$* | Filter Depth<br>*inches* | Effective Size<br>*$D_{10}$, mm* | Uniformity Coefficient<br>*$C_u$* | Dose Limit<br>*gal/orifice/dose* |
|---|---|---|---|---|---|
| Single pass | 1.25 | 24 ± | 0.30 ± | 3 to 4 | 0.25 |

Recirculating (multiple-pass) filters also treat septic tank effluent to advanced wastewater treatment levels or better. Below, in Figure 2, a typical recirculating filter is shown.

**Figure 2: Recirculating sand filter (RSF)**

Multiple-pass recirculating sand/gravel filters typically achieve the following average effluent levels:

**$cBOD_5$:** 10 mg/L
**TSS:** 10 mg/L
**$NO_3$-n:** 30 mg/L

Multiple-pass recirculating sand/gravel filters (RSFs or RGFs) have been most popular in applications with medium to large wastewater flows. They are ideal wastewater treatment systems for parks, restaurants, schools, office complexes, and large developments, and they are especially suited for communities with STEP and/or STEG effluent sewer collection systems. Typical multiple-pass recirculating sand/gravel filter design criteria are:

| Type of Operation | Design Loading Rate *gpd/ft²* | Recirc Ratio R:R | Filter Depth *inches* | Effective Size *$D_{10}$, mm* | Uniformity Coefficient *$C_u$* | Dose Limit *gal/orifice/dose* |
|---|---|---|---|---|---|---|
| Recirculating | 5 | 5:1 | 24 | 1.5 to 2.5 | 2 | 0.5 to 1.5 |

While sand/gravel media PBFs are, and will continue to be, an excellent choice for wastewater pretreatment, certain limitations have prevented them from being considered at all sites:

- **Land area** — Some sites lack the land area required for a sand filter. Single-pass sand filters for single-family homes typically require between 300 and 400 square feet, depending on jurisdictional design or flow criteria.

- **Media quality and accessibility** — Good quality sand media is occasionally not locally available, resulting in either high transportation costs or the use of inferior local media. In addition, getting sand to some sites—such as islands, mountainous regions, or other isolated areas—can be difficult.

- **Installation quality** — Sand filters are typically built onsite with locally available materials, and the quality of installation is partially contingent on the consistency of these materials, and the knowledge and ability of the installing contractor.

- **Serviceability** — The ease of maintaining a buried onsite single-pass sand filter has been a long-term design concern that resulted in robust designs with low loading rates. The low loading rates are intended to ensure 10 to 20 years of continuous usage with little to no intrusive filter maintenance because replacing the sand media can be difficult and costly.

## Textile-Based Packed Bed Filters

The efforts to improve loading capacities and serviceability have led to extensive research into a wide variety of media (e.g., foam, glass, styrene, plastic products, expanded clays, zeolite, limestone, furnace slag, peat, etc.). Over the past decade, this research has led to the development of an advanced technology for packed bed filters that uses an engineered textile medium assembled in a variety of configurations. Textile provides all the benefits inherent in the packed bed filter design but overcomes the limitations listed above.

- **Land area** — The land area needed is significantly smaller than that for sand filters because loading rates are 5 to 30 times higher (typically, 15-30 gpd/$ft^2$ with peak flow capacity/factor (PF) of 2.0 or greater, based on residential effluent quality as described in Tables 1 and 2). Thus, the footprint area for a textile filter serving a typical four-bedroom single-family home is now only about 20 square feet. If the textile filter is positioned over the processing tank, virtually no additional area is required.

- **Media quality and availability** — The manufactured textile medium ensures consistent quality and availability.

- **Installation quality** — Lightweight textile medium (4.0 lb/$ft^3$) and small filter size make pre-manufactured treatment units practical, eliminating onsite construction and reducing installation time, labor, and construction errors. These characteristics make textile systems ideal for cost-saving self-help programs and particularly suited for difficult-to-access and remotely located sites.

- **Serviceability** — Special configurations allow for ease of maintenance and cleaning without expensive or large excavation equipment, or the need for replacing the medium. A single-family residential filter can now be cleaned and serviced in as little as an hour.

The initial research on the textile medium began with small chips or "coupons" with a complex fiber structure, which offered an extremely large surface area for biomass attachment. Later research has been focused on developing textile filter blends and configurations that address early packed bed filter issues regarding ease of serviceability without sacrificing equivalent performance.

Porosity, attached growth surface area, and water-holding capacity contribute to the textile media's treatment performance.

- **Porosity** — The porosity of the textile media is several times greater than that of sand, gravel, and other particle-type mediums. The more porous the medium, the greater its hydraulic conductivity, the greater its air space (which enhances the capacity of passively ventilated systems and free air movement), and the greater its capacity for the accumulation of solids and biomass development.

- **Surface area** — Textile media can be blended with a variety of fibers to achieve relatively large total surface area per unit volume ($ft^2/ft^3$). In current media blends, the typical attached-growth surface area is 4-8 times greater than recirculating filter media. Expanding the biomass growth area provides a greater surface potential for air and effluent to interface and come in contact with the biomass.

- **Water-holding capacity** — The water-holding capacity of textile media also varies considerably depending on the media density, type of material, and blend of fibers. The water-holding capacity in textile media is also several times greater than expected in the sands and gravels used in filters. Water-holding capacity performs a key function in the treatment process. Together with the programmed dosing time and frequency, it governs the effluent retention time within the

filter and ultimate effluent quality. In Figure 3, complex fiber structure and void space of textile fibers is compared to that of typical 0.30-mm and 1.5-mm sand particles.

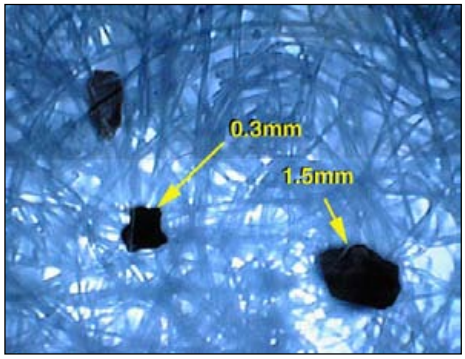



**Figure 3: Textile fiber porous structure, relative to sand and gravel particles**

## Performance of Textile-Based Packed Bed Filters

In the past three years, performance evaluations have been conducted and reported on by facilities such as the University of California, Davis Campus; NSF International; and NovaTec Consultants, Inc. of Vancouver, British Columbia. The University of California Davis study (Leverenz, et al., 2000) was conducted following standard method composite sampling and testing procedures. The evaluations performed by NSF International and NovaTec Consultants (Vassos and Turk, 2002) were conducted per ANSI/NSF Standard 40 protocol. The ANSI/NSF Standard 40 evaluation resulted in the first ever certification of a packed-bed textile filter under ANSI/NSF Standard 40 for Residential Wastewater Treatment Systems. Over the course of the NSF40 evaluation, the average effluent $cBOD_5$ was 5 mg/L and the average effluent TSS was 4 mg/L at a hydraulic loading rate of 29.1 gpd/ft$^2$. The units evaluated contained vertically aligned textile sheets (AX) as shown in Figure 4. The evaluations successfully established the ability of this configuration to meet advanced wastewater treatment levels and surpassed, by a considerable margin, the effluent quality performance requirements established by ANSI/NSF Standard 40 for Class I effluent.

**Figure 4: AX20 AdvanTex® filter with aligned textile sheets**

Additional performance evaluation demonstrated the ability of the unit to function under peak design hydraulic and solids-loading conditions for extended periods of time, without service. Over a span of nearly 14 months, NovaTec Consultants (Vassos and Turk, 2002) continuously evaluated performance under peak hydraulic loading conditions (HLR). For 10 of those months, the HLR exceeded 60 gpd/ft$^2$, and for a period of about 3.5 months the loading rate was 48.3 gpd/ft$^2$.

During these evaluations, influent organic levels and solids loading levels reached or exceeded peak monthly limits, with daily influent levels reaching highs of 525 mg/L $cBOD_5$ and 1600 mg/L TSS. This demonstrated the resiliency of this unit, under adverse conditions, to consistently produce secondary and advanced treatment quality effluent.

Figure 5 illustrates the relative levels of effluent quality achieved by the three AX units throughout these evaluations. The graph represents over 360 data days of composite sampling over a time span of more than two years.

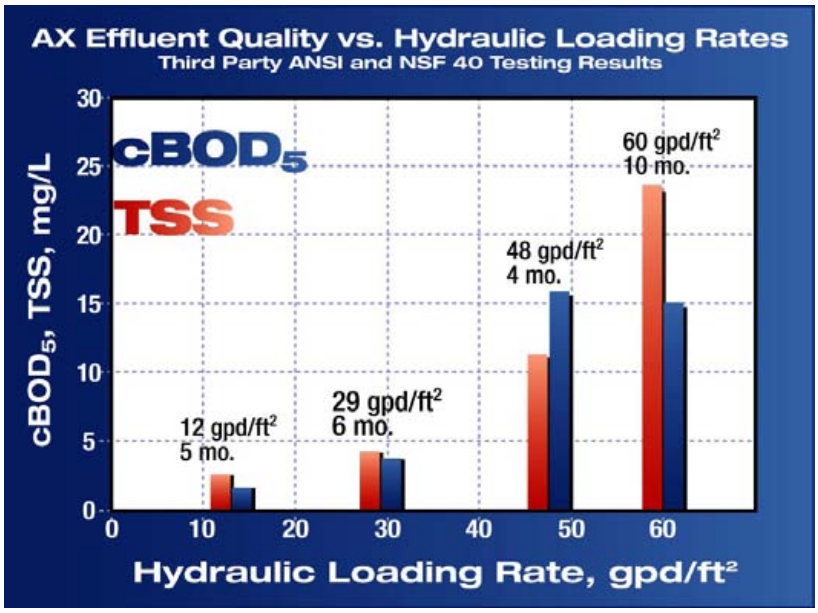



**Figure 5: Effluent quality achieved relative to actual hydraulic loading rates**

Figures 6a and 6b illustrate the correlation between $cBOD_5$ and TSS removal and direct influent loads, as well as the system's strong removal capacity, overall.

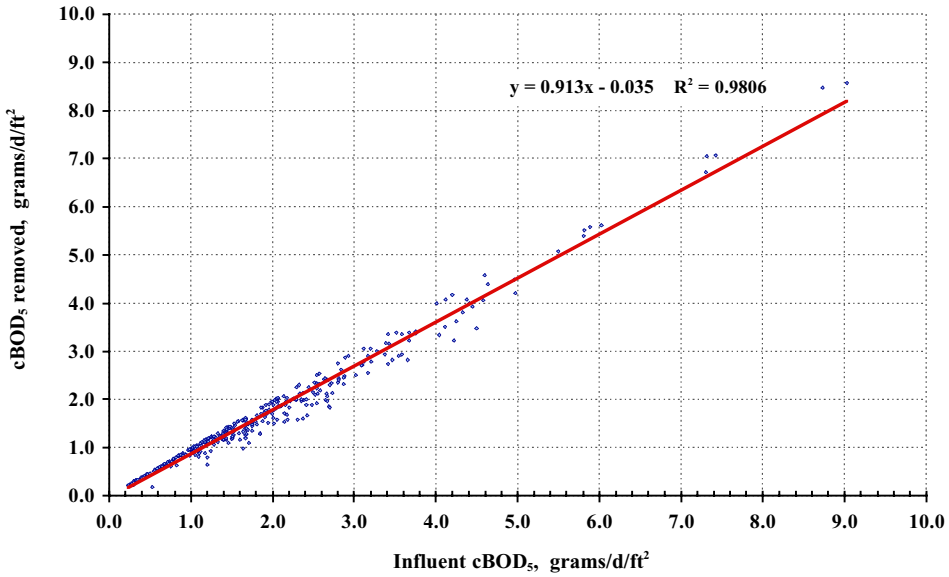



**Figure 6a: $cBOD_5$ removal relative to influent loading**

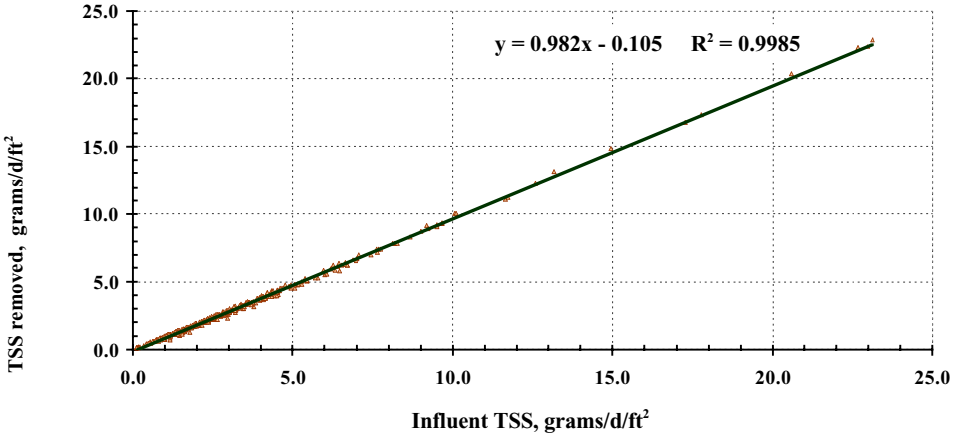



**Figure 6b: TSS removal relative to influent loading**

Textile filter performance, showing effluent quality consistently better than 10/10 mg/L $cBOD_5$ and TSS has also been documented in several case studies (Bounds/Ball, 2000). Textile filters are currently being used in more than two thousand commercial, cluster, and residential sites across the U.S and Canada.

## Additional Attributes of Packed Bed Filters

All small-scale wastewater systems serving individual homes or clusters of homes need to meet the following requirements:

- Quick startup
- Efficient performance with highly variable wastewater strengths and flows, including occasional hydraulic and biologic overloads
- No release of untreated sewage if a malfunction occurs

- Consistent trouble-free operation; low maintenance (e.g. annual service call recommended; on-site routine service time 1 hour ±)
- Ease of maintenance (components should be easily accessible and serviceable)
- Low energy consumption
- Adequate storage during power outages (normally 24 hours or more at typical flows)
- Recoverable and expandable
- Reliability in providing the level of treated water required to final dispersal treatment processes

Packed bed filters are inherently well suited for small-scale wastewater systems. They meet and typically exceed the above-listed requirements, due to the design and operational features described below:

**The Role of Watertight Tanks**
Watertight septic tanks, which precede PBFs, provide several benefits:

1) Allow primary settling of solids so that the packed bed filter treats largely liquid waste,
2) In conjunction with programmable timer controls, modulate and buffer large and uneven inflow, and
3) Provide emergency storage during power outages or equipment breakdowns. In multiple-pass recirculating PBFs, the recirculation tank provides even more buffering capacity by diluting the incoming septic tank effluent with treated effluent, to mitigate the effects of organic shock loading.

**"Fail-safe" design** — Most PBF designs do not allow completely untreated sewage to be released since, unlike passive gravity-in/gravity-out systems, wastewater must pass through the treatment media before discharge. This feature also prevents deliberate attempts to disable the treatment system. With passive gravity-in/gravity-out suspended growth aerobic systems, it is not uncommon for users to "unplug" their aeration system to lower their electrical bill. With typical packed bed filters, only the filtrate is discharged, ensuring high effluent quality dispensed for final dispersal.

**Flow management** — PBF systems with programmable timers in their control panels have the ability to detect excessive inflow caused by infiltration, leaky plumbing fixtures, or higher-than-normal water consumption by the user. This "flow management" provided by the programmable timer is a fundamental tool that allows operators to detect and diagnose problems that would otherwise go undetected until complete system failure. The programmable controllers also provide improved treatment through frequent "micro-dosing" of the PBF.

**Speed of startup** — The startup capability of PBFs is generally unsurpassable. Since PBFs utilize mechanical filtration as a means of physically removing matter, they are able to achieve high levels of effluent quality within hours of startup. The textile filters evaluated under the testing protocols described earlier demonstrated the ability to remove more than 80% $cBOD_5$ within the first day of operation, and TSS concentrations under 15 mg/L were measured.

**Low power requirements** — Power costs are low because of the intermittent operation of small fractional horsepower pumps. A typical single-pass PBF for an average single family home only requires 4-12 kWh/mo. At the national average of 8 cents per kWh, the power cost ranges from 32 to

96 cents per month. Depending on the operating recirc-ratio, multiple-pass recirculating PBFs may cost 3 to 5 times more to operate than single-pass PBFs, depending on the operating recirc-ratio.

**Low routine maintenance requirements** — Annual routine maintenance for PBFs is recommended and normally includes inspection of effluent for clarity (e.g., turbidity, grease and oily films, foam, color, etc.) and odor, as well as cleaning pump filters and flushing distribution piping if necessary. Because PBFs are designed to limit cell mass growth by controlling the organic loading rate and encouraging endogenous respiration, sludge removal is not required from the PBF itself. Solids do build up in the septic tank and must be removed periodically. The pumping of septic tank solids can be as infrequent as every 12 years or more, if solids accumulations are "monitored" every 2-3 years to determine when the tank actually needs pumping.

**Ease of maintenance** — Maintenance of pre-manufactured, packaged PBF's is particularly service friendly and especially suited for management programs, due to a) Training and certification of installers and service providers, b) Detailed installation and operation manuals that identify specific sevice, testing and troubleshooting techniques, c) Specially engineered mediums, as shown in Figure 9, that can be cleaned with a small pressure washer in the event of system abuse or overuse and put back into service within a matter of minutes, and d) Controls that monitor and alert service providers directly upon electro-mechanical malfunctions, as well as water usage and system functioning abnormalities.

As a result, the management of onsite systems can be as user-friendly, effective, reliable, and trouble-free as the municipal gravity alternative and, in the event of an individual malfunctions, much more manageable and environmentally friendly.

**Figure 9: Typical servicing of AdvanTex textile medium. (An underdrain valve is opened during a filter washdown that allows sloughed solids to flush back into the process tank, so there is no removal or wasting of media.)**

## General Design Considerations

In more than 12 years of research with textile media, several design variations have been tested in both intermittent and recirculating operations and in several different multi-pass recirculating "modes," which optimize nutrient reduction. Like commercial sand and gravel filter installations, commercial textile filter installations are typically operated in multiple-pass recirculating modes. However, unlike residential sand filter installations, which are normally operated as single-pass systems, residential textile technology filters are also configured as multi-pass, recirculating systems, as shown in Figure 7.

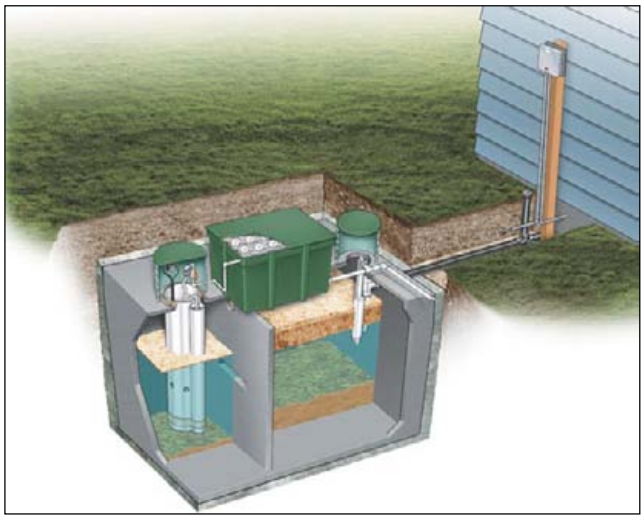


**Figure 7: Perspective view of textile filter unit and processing tank system**

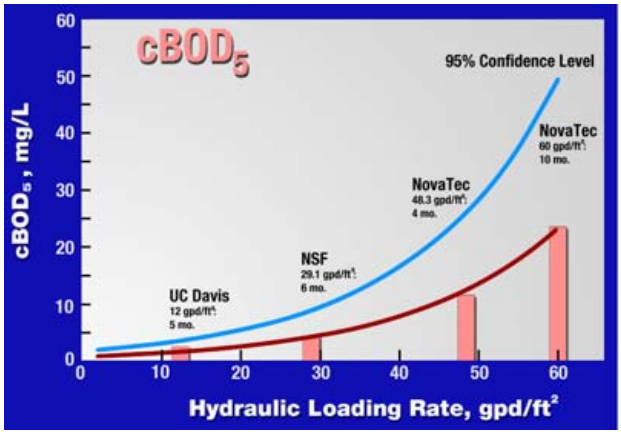
Because the loading rates are dependent on the influent characteristics, a careful and critical evaluation of the contributing source(s) is the first crucial step in adequately accounting for the filter's design size and capacity. Hydraulic, organic, and inorganic inputs (loads) are characteristics that will play critical short and long-term parts in all wastewater treatment designs.

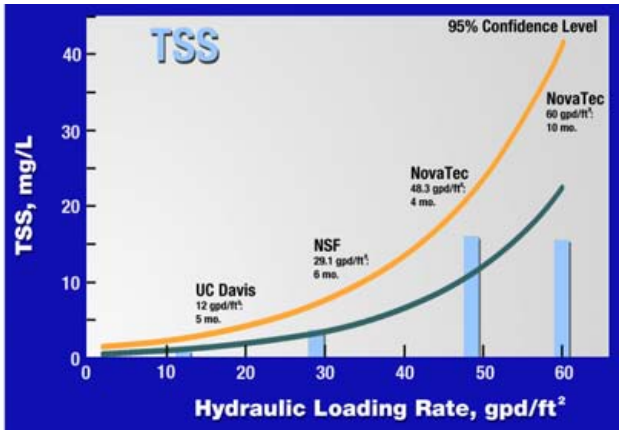
In single-pass applications, it is common to find a screened pump vault located at the outlet of the septic tank, where the septic tank's effluent is drawn from the clear zone of the tank in a decanting manner. The screened effluent is often dosed directly to the single-pass filter. In multiple-pass recirculation processes the clear-zone supernatant discharges into a secondary chamber or tank, which is typically called the recirculation, recirc/blend, or dilution/blend chamber or tank. Typically primary treated effluent from a septic tank *should not average higher than the following parameters, shown in Table 2,* when being further treated by *onsite* filtration and disposal:

**Table 2: Typical Residential Wastewater Characteristics**

| Source | Flow | $BOD_5$ | TSS | Grease | Reference |
|---|---|---|---|---|---|
| | *gpcd* | *mg/L* | *mg/L* | *mg/L* | |
| Raw Domestic Sewage | *47* | *371* | *338* | *73* | *EPA, M&E Building sewers* |
| Raw Domestic Sewage | *50* | *450* | *503* | *164* | *Crites-Tchobanoglous, SDWM-1998* |
| Septic Tank Effluent | *48* | *156* | *84* | *17* | *EPA non-screened ST effluent* |
| Screened ST Effluent | *60* | *133* | *30* | *n/a* | *Screened ST effluent (12 Communities)* |

Designing at 95% confidence levels, as shown in Figure 8a and 8b, tends to ensure reliability in meeting discharge limits consistently within the variability of the occasional excessive loading and operating conditions.




**Figures 8a and 8b: AdvanTex® effluent quality relative to hydraulic loading rates, at 95% confidence levels**

## Conclusion

Test data from residential and commercial packed bed filters incorporating textile media has shown that textile filters provide consistent, high quality wastewater treatment: better than 10/10 $cBOD_5$/TSS. Consequently, they have proven to be an ideal solution in the following, diverse applications:

- New onsite wastewater treatment systems
- Repairs and reclamation projects
- Jurisdictions requiring nutrient reduction
- Seasonal or periodically used facilities
- Facilities with extreme variations in daily flows
- Overloaded single and multiple-pass sand and gravel filters
- Wherever water reuse is essential

Moreover, effluent sewers incorporating textile filter treatment units can be used to replace failing conventional collection and treatment systems.

Because textile is lightweight, it can be incorporated into small, affordable, pre-manufactured treatment units. And because the units are modular, they permit easy system expansion in the event of continued over-use or under-design.

Orenco's AdvanTex® brand textile packed bed filters have made a major impact in addressing user, environmental, and management issues relating to onsite wastewater treatment. Like many onsite technologies, AdvanTex® brand textile packed bed filters treat wastewater more reliably, more affordably, and with considerably less environmental impact than centralized sewers do. With designers, regulators, distributors, installers, maintenance personnel, and users all working together to deliver a high quality, highly serviceable product, textile packed bed filters can help us take a significant step towards demonstrating the viability of decentralized and onsite systems.

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# AdvanTex® Treatment Systems

**Performance Summary**
**Provided by Orenco Systems®, Inc.**

Since 2001, the performance of AdvanTex® Treatment Systems has been tested in nearly a dozen different programs. These include testing performed by outside companies or agencies (third-party); contract testing performed by Orenco distributors (second-party); and Orenco's own testing (first-party). More than 1000 data points are represented in these tests. The results show that AdvanTex systems easily meet advanced treatment standards for BOD, TSS, and total nitrogen.

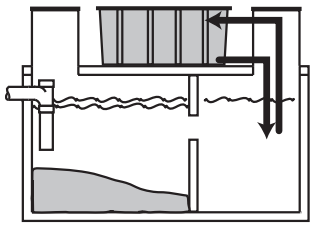
## About System Configurations

As shown in the illustrations below, AdvanTex systems can be configured in two ways depending on the degree of total nitrogen reduction required. In Mode 1, filtrate from the AdvanTex pod is recirculated to the secondary chamber of the septic tank. In Mode 3, the filtrate is recirculated to the primary chamber, where the environment favors further denitrification.

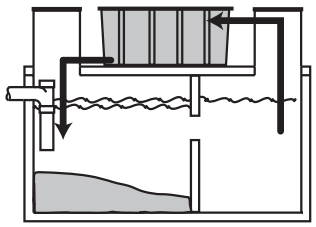
In Virginia, North Carolina, and Rhode Island, some of the systems tested in Mode 1 incorporated two tanks, a primary tank and a recirculation tank. In the primary tank, sludge and scum are separated from liquid effluent, which then flows into a separate recirculation tank, into which the AdvanTex filtrate is recirculated.

## About the Results

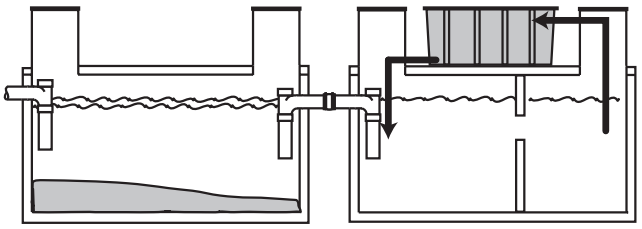
The pages that follow summarize the results of these testing programs. For ease of comparison, we have included information about the circumstances of each test. If you have any questions regarding this summary, please contact Sam Carter, Government Relations Manager, Orenco Systems, Inc., (800) 536-4192, e-mail: scarter@orenco.com.



**Mode 1 with processing tank**



**Mode 3 with processing tank**



**Mode 1 with primary tank and recirculation tank**

## BRITISH COLUMBIA

### NSF Standard 40 Testing
### AX20 Mode 1 *(Third-Party)*

**About the Testing:** Orenco contracted with Novatec to test an AX20 Mode 1 system in support of its application for NSF approval. Novatec conducts official NSF/ANSI Standard 40 testing under contract to manufacturers at its facility in Squamish, British Columbia. Testing is done at a wastewater facility that serves a residential subdivision. Composite sampling was used throughout this evaluation.

Although the NSF/ANSI Standard 40 protocol does not require it, Orenco elected to sample for total nitrogen.

**Dates:** May 2001-November 2002
Total nitrogen testing: August 2001-February 2002

**Average Daily Flow:** 500 gpd

**System Configuration:** Mode 1 recirculating into the second compartment of a 1500-gallon tank

#### *Processing Tank Influent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| Mean | 166 | 292 | 33 |
| Median | 140 | 200 | 32 |
| Standard Deviation | 82 | 219 | 8 |
| Number of Samples | 108 | 108 | 27 |

#### *AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* | *Turbidity (NTU)* |
|---|---|---|---|---|
| **Mean** | **5** | **4** | **12** | **4** |
| Median | 3 | 3 | 13 | 4 |
| Standard Deviation | 3 | 6 | 3 | 1 |
| Number of Samples | 109 | 109 | 27 | 118* |
| Percent Reduction | 97% | 99% | 64% | NA |

** Took samples during stress periods*

# BRITISH COLUMBIA

## Startup Testing, AX20 Mode 1 *(Third-Party)*

**About the Testing:** This was part of Orenco's NSF/ANSI Standard 40 official testing, conducted by Novatec. The Standard 40 protocol allows a start-up period of three weeks. We elected to start testing within *three days* of startup. Below is the average performance for the first five days. Composite sampling was used throughout this evaluation.

**Dates:** May 2001

**Average Daily Flow:** 500 gpd

**System Configuration:** Mode 1 recirculating into the second compartment of a 1500-gallon processing tank

### Processing Tank Influent

| | $cBOD_5$ (mg/L) | TSS (mg/L) |
|---|---|---|
| Mean | 204 | 316 |
| Number of Samples | 5 | 5 |

### AdvanTex Effluent

| | $cBOD_5$ (mg/L) | TSS (mg/L) | Turbidity (NTU) |
|---|---|---|---|
| **Mean** | **17** | **4** | **9** |
| Number of Samples | 5 | 5 | 5 |
| Percent Reduction | 98% | 99% | |

# BRITISH COLUMBIA

## AX20 Mode 3 *(Third-Party)*

**About the Testing:** After completion of the NSF/ANSI Standard 40 testing, Orenco contracted with Novatec to evaluate denitrification performance of the same AX20 system in Mode 3. Composite sampling was used throughout this evaluation.

**Dates:** December 2002-December 2003

**Average Daily Flow:** 500 gpd

**System Configuration:** Mode 3 recirculating into the primary compartment of a 1500-gallon processing tank

### Processing Tank Influent

| | $cBOD_5$ (mg/L) | TSS (mg/L) | Total N (mg/L) |
|---|---|---|---|
| Mean | 112 | 170 | 34 |
| Median | 104 | 137 | 33 |
| Standard Deviation | 42 | 48 | 7 |
| Number of Samples | 7 | 7 | 5 |

### AdvanTex Effluent

| | $cBOD_5$ (mg/L) | TSS (mg/L) | Total N (mg/L) | Turbidity (NTU) |
|---|---|---|---|---|
| **Mean** | **7** | **9** | **10** | **9** |
| Median | 5 | 5 | 10 | 6 |
| Standard Deviation | 8 | 9 | 3 | 5 |
| Number of Samples | 9 | 9 | 24 | 23 |
| Percent Reduction | 94% | 95% | 71% | NA |

# COLORADO

## Roger Shafer, "Use of a Recirculating Textile Filter Followed by a Polishing Sand Filter…,"* AX20 Mode 3 *(Second-Party)*

**About the Testing:** This test involved one AdvanTex system at a single-family home.

**Dates:** Summer 2001

**Average Daily Flow:** 209 gpd (April 2001-August 2001)

**System Configuration:** This system consisted of two AX10s (which together have the same treatment capacity as an AX20), configured in Mode 3, recirculating to the primary compartment of a 1500-gallon processing tank.

### Septic Tank Effluent**

| | $cBOD_5$ (mg/L) | TSS (mg/L) | Total N (mg/L) | Fecal Coliform*** (col/100 mL) |
|---|---|---|---|---|
| Mean | 154 | 96 | 38 | >10,000 |
| Number of Samples | 5 | 5 | 5 | 5 |

### AdvanTex Effluent

| | $cBOD_5$ (mg/L) | TSS (mg/L) | Total N (mg/L) | Fecal Coliform*** (col/100 mL) |
|---|---|---|---|---|
| **Mean** | **5** | **6** | **13** | **4522** |
| Number of Samples | 5 | 5 | 5 | 5 |
| Percent Reduction | 97% | 94% | 66% | NA |

** Roger Shafer, "Use of a Recirculating Textile Filter followed by a Polishing Sand Filter for Onsite Wastewater Treatment in Colorado's Fractured Bedrock Environment," presented at the Fractured-Rock Aquifers 2002 Conference, March 13-15, Denver, Colorado*

*** Five septic effluent samples were collected from the system between April and May 2001 using a 3/4-in. clear plastic tank sampler. Samples were collected from the outlet tee of the septic tank before installation of the AdvanTex system.*

**** Calculated as geometric mean*

# COLORADO

## Jefferson County Required Testing AX20 and AX30 Mode 3 *(Second-Party)*

**About the Testing:** Orenco distributor Roger Shafer sampled 27 systems at single-family residences as required by the Jefferson County Health Department as an operating permit requirement.

**Dates:** October 2003 and May 2004

**System Configuration:** Three AX20 systems and twenty-three AX30 (AX20 & AX10) systems were all configured as Mode 3, recirculating into the primary compartment of a processing tank.

### AdvanTex Effluent

| Total N (mg/L) | AX30 | AX20 |
|---|---|---|
| **Mean** | **17** | **17** |
| Median* | 14 | 14 |
| Standard Deviation* | 5 | 2 |
| Number of Samples | 37 | 7 |

** For the 10 sites that have more than one sample*

# NEW YORK

## Skaneateles Demonstration Project
## AX20 Mode 1 *(Third-Party)*

**About the Testing:** This testing is being performed as part of the Skaneateles Demonstration Project. The purpose of this project is to evaluate the performance and management of innovative technologies on single-family residences. As part of this project, one AX20 system was installed at a single-family residence and tested.

**Dates:** November 2004-December 2005

**Average Daily Flow:** 106 gpd

**System Configuration:** Mode 1 recirculating into the second compartment of a 1500-gallon processing tank.

### *Mode 1 Systems, AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| **Mean** | **4** | **3** | **20** |
| Median | 2 | 3 | 19 |
| Standard Deviation | 4 | 2 | 4 |
| Number of Samples | 9 | 9 | 9 |

# NEW ZEALAND

## AX20 Mode 3 *(Third-Party)*

**About the Testing:** Testing of residential wastewater treatment systems was initiated by the Rotorua District Council and Environment Bay of Plenty, the Regional Council. The purpose of the project is to compare systems so that manufacturers that meet their specifications can be preapproved. The one-year trial is focused particularly on nitrogen reduction, and includes "stress testing" and vacation simulation as well as monitoring of each system's power usage.

**Dates:** May 2005-January 2006

**Average Daily Flow:** 265 gpd

**System Configuration:** Mode 1 recirculating into the second compartment of a 1500-gallon processing tank.

### *Processing Tank Influent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| Mean | 199 | 301 | 66 |
| Median | 209 | 232 | 62 |
| Standard Deviation | 95 | 239 | 24 |
| Number of Samples | 33 | 31 | 60 |

### *AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| **Mean** | **3** | **4** | **22** |
| Median | 3 | 4 | 17 |
| Standard Deviation | 2 | 3 | 10 |
| Number of Samples | 26 | 26 | 62 |
| Percent Reduction | 98% | 99% | 67% |

# NORTH CAROLINA

## Controlled Demonstration Testing Program
## AX20 Mode 1 and Mode 3 and AX100 *(Second-Party)*

**About the Testing:** This test, conducted under state oversight, involved 15 AdvanTex systems at single-family homes and vacation rentals. The data include results from both AX20 and AX100 systems.

**Dates:** August 2003-present

**Average Daily Flow:** 75-2200 gpd

**System Configuration:** All but one system were configured as Mode 1 with recirculation into a recirculation tank located after a separate primary septic tank. A single system was configured as Mode 3 with a single processing tank.

### *Mode 1 Systems, Septic Tank Influent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N* (mg/L)* | *Fecal Coliform** (col/100 mL)* |
|---|---|---|---|---|
| Mean | 214 | 55 | 67 | NA |
| Median | 231 | 57 | 72 | NA |
| Standard Deviation | 90 | 13 | 19 | NA |
| Number of Samples | 30 | 30 | 26 | NA |

### *Mode 1 Systems, AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N*** (mg/L)* | *Fecal Coliform** (col/100 mL)* |
|---|---|---|---|---|
| **Mean** | **4** | **5** | **25** | **1655** |
| Median | 4 | 5 | 22 | 1710 |
| Standard Deviation | 2 | 2 | 11 | 2857 |
| Number of Samples | 47 | 46 | 42 | 27 |
| Percent Reduction | 98% | 91% | 63% | NA |

### *Mode 3 Systems, AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N*** (mg/L)* | *Fecal Coliform** (col/100 mL)* |
|---|---|---|---|---|
| **Mean** | **6** | **6** | **12** | **2312** |
| Median | 5 | 6 | 12 | 2800 |
| Standard Deviation | 2 | 1 | 2 | 2652 |
| Number of Samples | 3 | 3 | 2 | 3 |

* *TN as TKN*

** *Calculated as geometric mean*

*** *TN = TKN + $NO_3$-N + $NO_2$-N*

# OREGON

## La Pine National Demonstration Project
## AX20 Mode 3 *(Third-Party and First-Party)*

**About the Testing:** This project is a cooperative effort by the Deschutes County Environmental Health Division, the Oregon Department of Environmental Quality, and the U.S. Geological Survey. The purpose of the project was to evaluate innovative denitrification technologies in an area of the state where climate and soil conditions are unfavorable for denitrification and the risk of groundwater contamination is high. As part of the project, three AX20 systems were installed at single-family residences. In addition to the samples required for the project, some samples were collected by Orenco.

**Dates:** January 2002-present

**Average Daily Flow:** 108-334 gpd

**System Configuration:** Mode 3 recirculating into the primary compartment of a 1500-gallon processing tank

### *Septic Tank Effluent**

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* | *Fecal Coliform** (col/100 mL)* |
|---|---|---|---|---|
| Mean | 288 | 112 | 61 | $5.5 \times 10^4$ |
| Median | 270 | 66 | 62 | $4.0 \times 10^4$ |
| Standard Deviation | 140 | 204 | 20 | $4.5 \times 10^6$ |
| Number of Samples | 70 | 70 | 70 | 70 |

* *Average of all other sites where septic tank effluent is being sampled*
** *Calculated as geometric mean*

### *Mode 3 Systems, AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* | *Fecal Coliform* (col/100 mL)* |
|---|---|---|---|---|
| **Mean** | **11** | **7** | **17** | **$2.0 \times 10^4$** |
| Median | 10 | 6 | 16 | $2.3 \times 10^4$ |
| Standard Deviation | 5 | 3 | 6 | $9.9 \times 10^3$ |
| Number of Samples | 92 | 94 | 92 | 67 |
| Percent Reduction | 96% | 94% | 72% | 64% |

* *Calculated as geometric mean*

# RHODE ISLAND

## Green Hill Pond Watershed Demonstration Project
## AX20 Mode 3 *(Third-Party)*

**About the Testing:** The University of Rhode Island Cooperative Extension On-site Wastewater Training Center constructed and is testing several innovative septic systems, including five AdvanTex systems, in the Green Hill Pond Watershed. The Training Center is evaluating the systems' performance and using the installations to train installers, homeowners, designers, and regulators.

**Dates:** August 2003-present

**System Configuration:** The project includes five AX20s at single-family homes, all configured as Mode 3, recirculating into the primary compartment of a 1500-gallon processing tank.

### *Mode 3 Systems, AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| **Mean (all sites)** | **7** | **5** | **19** |
| Median | 4 | 2 | 13 |
| Standard Deviation | 6 | 8 | 18 |
| Number of Samples | 9 | 9 | 9 |

# VIRGINIA

## AX20 Mode 1 and Mode 3 *(Third-Party)*

**About the Testing:** Conducted by Mark Gross, PE, PhD, of the University of Arkansas Department of Civil Engineering, this test involved AX20 systems installed at 13 single-family homes.

**Dates:** October 2002-present

**Average Daily Flow:** 90-308 gpd

**System Configuration:** Mode 1 (4 sites) recirculating into a recirculating tank located after a separate primary septic tank; Mode 3 (13 sites) recirculating into the primary compartment of a 1500-gallon processing tank

### *Mode 3 Systems, AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| **Mean** | **5** | **7** | **19** |
| Median | 4 | 7 | 18 |
| Standard Deviation | 7 | 7 | 11 |
| Number of Samples | 85 | 85 | 85 |

# VARIOUS LOCATIONS

## AX100 *(First-, Second-, and Third-Party)*

**About the Testing:** Data is being collected from twenty-one AX100 systems on various commercial and large residential applications.

**Dates:** June 2002-present

**Average Daily Flow:** 1100-120,000 gpd

**System Configuration:** All the systems are AX100s. None are configured to achieve the maximum amount of nitrogen reduction possible.

### *Septic Tank Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| Mean | 410 | 128 | 55 |
| Median | 361 | 77 | 53 |
| Standard Deviation | 261 | 171 | 24 |
| Number of Samples | 35 | 35 | 11 |

### *AdvanTex Effluent*

| | *$cBOD_5$ (mg/L)* | *TSS (mg/L)* | *Total N (mg/L)* |
|---|---|---|---|
| **Mean** | **7** | **7** | **18** |
| Median | 5 | 5 | 19 |
| Standard Deviation | 5 | 4 | 15 |
| Number of Samples | 161 | 161 | 44 |
| Percent Reduction | 98% | 95% | 60% |